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Science Education

ANNOUNCEMENT

In 1916 General Science Quarterly was founded. For thirteen years this journal, under the editorial direction of Walter G. Whitman, had as its mission the promotion of the teaching of general science, a new subject in the secondary curriculum. Thirteen years later General Science Quarterly became Science Education. At that time, it was believed that a journal to promote general science no longer existed because this subject had proved its worth. Accordingly, as Mr. Whitman wrote in an editorial in the May, 1929, issue of Science Education, ". . . it is important that there be at least one journal on science education whose only purpose is the promotion of science teaching in our schools. Such a journal has now been started—you are now reading from its first number."

The enlarged scope and plans for the new journal were described in the November, 1929, issue. The purposes there stated have been modified only slightly since that time. Science Education has continued to be an open forum on problems and practices of teaching science as a part of general education at the various school levels. In addition to this mission it has directed attention to the education of science teachers. It has been the policy of the editorial board to print among the articles and editorials discriminating and challenging points of view. We have attempted to provide analytical and constructive discussions and reports on the philosophy of science education, content and objectives of science teaching, psychology of learning in science, instructional materials, and measurement of learning products. Now and then we have included research studies but there has never been the policy of limiting the journal to reports of investigations despite the reports which have come to us from some who have not followed closely the purposes and content of the publication.

Naturally we are pleased with the many words of commendation which have come to our desk. The appeal of the journal, the constructive activities of our efficient Business Manager, and the support of our subscribers and advertisers have made it possible for us to carry forward our purposes. We are now pleased to announce an expansion of the journal from a quarterly to seven issues each year. The present volume (Volume 21) will have three additional issues to be published in October, November and December. The next volume (Volume 22) will appear in seven issues for January, February, March, April, October, November, and December. The new subscription price, beginning with the present issue, is two dollars and fifty cents.

We take this occasion to express our thanks to all who have given us help during the years past and to invite our readers to submit to us for publication articles, classroom notes, editorials and news notes, to the end that we may better realize our objective to make of Science Education an open forum of challenging and helpful discussions relating to the theory, content, materials and practices of instruction in science. Through the contributions which we receive and publish we may hope to improve the place of science in general education.

—*The Editor.*

A STUDY OF ALLUSIONS TO SCIENCE IN MAGAZINES

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One purpose in teaching science is to make it possible for people to understand the allusions to science met in reading matter. With this purpose in mind several investigations have been made to discover the science terms found most frequently in current periodicals. However, several criticisms may be made on these studies. In the first place, the word forms of science and not the contexts or meanings of these word forms were tabulated. Thus the investigations by Downing,[1] Burkhart,[2] and Powers[3] reveal only the raw science terms rather than the contexts or meanings with which these terms appear in the materials analyzed. Furthermore, the magazines used in these studies were of the more specialized and high standard type rather than the more commonly read but apparently desirable magazines. Finally, the period of time covered by the periodicals used in the investigations was too brief to obtain a truly representative sampling of material.

It is apparent that, in attempting to determine the understanding necessary for the reading of science allusions, one must first discover the particular meaning associated with a given allusion or science term in the particular setting in which the allusion is used in the material analyzed. With such data at hand one would have a more satisfactory idea of what should be taught about the allusion. Furthermore, the material analyzed should represent the commonly read but apparently desirable magazines rather than high standard or more specialized magazines. Also, an analysis of magazines covering a ten-year period, rather than the short period covered by available studies, should give a more truly representative sampling as well as information needed relative to the persistency of allusions. Finally, allusions found in advertisements must be given consideration as well as allusions occurring in ordinary reading selections.

In the present investigation, eleven commonly read and apparently desirable magazines, issued during the ten-year period, 1921 to 1930 inclusive, were analyzed to determine the most frequently occurring allusions with their contexts or meanings. Of the literary type of magazine, the *Atlantic Monthly, Harper's Magazine,* and *Literary Digest* were chosen. Of the home type, *Good Housekeeping, Ladies' Home Journal,* and *Woman's Home Companion* were used. Of the story type, *Saturday Evening Post, Collier's Weekly,* and *American Magazine* were used; and of the child type, *St. Nicholas* and *Child Life* were analyzed. The basis for determining the popularity of these magazines was the circulation given in the *Directory of Newspapers and Periodicals.*[4]

Both weekly and monthly magazines were used in this investigation. If only monthly magazines had been used the total number of issues examined would have been 120. However, all the issues of the weekly magazines for a given month were examined. This increased the total number of issues analyzed for the ten-year period to 201.

The issues of the eleven magazines analyzed were as evenly distributed as possible over the ten-year period. Two issues of several magazines were used in each of the first four years. This was due to the fact

[1] Downing, Virginia. *Biology in Current Magazines in Relation to Biological Textbooks for Secondary Schools.* Unpublished Master of Arts Thesis, Colorado State Teachers College, Greeley, 1927.

[2] Burkhart, O. E. *Concepts of Pupils in Secondary School Science.* Unpublished Master of Arts Thesis, Colorado State Teachers College, Greeley, 1928.

[3] Powers, S. R. "Vocabularies of High School Science Textbooks," *Teachers College Record,* 26: 368–382, January, 1925.

[4] Ayer, N. W., and Son. *Directory of Newspapers and Periodicals.* N. W. Ayer and Son, Inc., Philadelphia, 1930.

that issues of three other magazines were inaccessible for the earlier years. For example, *St. Nicholas, Collier's, Ladies' Home Journal* and *Harper's* each occurred twice in 1921. Thus the distribution of magazines for 1921 was made in this manner: January, *St. Nicholas;* February, *Harper's;* March, *Atlantic Monthly;* April, *Ladies' Home Journal;* May, *Collier's;* June, *Good Housekeeping;* July, *American Magazine;* August, *Literary Digest;* September, *St. Nicholas;* October, *Collier's;* November, *Ladies' Home Journal;* and December, *Harper's.*

All of the eleven magazines were represented in each year from 1925 through 1930. They were distributed in the following order for 1925. January, *Harper's;* February, *Atlantic Monthly;* March, *Child Life;* April, *Saturday Evening Post;* May, *Woman's Home Companion;* June, *Collier's;* July, *Good Housekeeping;* August, *American Magazine;* September, *Ladies' Home Journal;* October, *Woman's Home Companion;* November, *Literary Digest;* and December, *St. Nicholas.* Since there were only eleven magazines, it will be noted that one magazine, *Woman's Home Companion,* was used twice in this year. The same sort of doubling, using a different magazine, was done for each of the following years.

No magazine was used twice in any month throughout the period covered. *St. Nicholas,* for example, was distributed in the following order: January, 1921; February, 1924; March, 1929; April, 1922; May, 1927; June, 1930; July, 1928; August, 1922; September, 1921; October, 1926; November, 1923; and December, 1925. All magazines analyzed were distributed in a similar manner.

It is evident that in such a selection of issues all the possible allusions to science occurring in this period have not been included. However it was thought that such sampling would give a reliable indication of the science terms people meet in their reading of the four types of popular magazines mentioned above, and that it would preclude the possibility of biased data resulting from the concentration of attention upon consecutive issues over a short period of time.

Every page of each issue was analyzed for science allusions, the advertisements as well as the stories and the articles, or content. Each allusion with its meaning or context was tabulated as it occurred. Only those words alluding directly to science were recorded. If the word "food" was used in connection with some biological factor such as health or growth, it was recorded; otherwise it was not. The data consisting of 2,490 different allusions to science with their 24,022 attendant contexts were recorded on sheets and filed.

A survey of these original data reveal significant facts concerning the frequency of occurrence of the allusions. For example, the term "electricity" occurred 443 times in the content and 109 times in the advertisements with a total frequency of 552. The term "radio" occurred 282 times in the content and 193 times in the advertisements of the magazines, making a total frequency of 475. Only one allusion, "electricity," occurred 500 times or more. Three allusions, "radio," "acid," and "teeth" occurred within a frequency range of 400 to 499; and four allusions, "science," "vitamin," "germ," and "skin" occurred within a frequency range of 300 to 399. It was found that 392 allusions had a frequency count of three each; 488 allusions had a frequency count of two each; and 134 allusions occurred but once. These figures reveal the significant fact that while 41 per cent of the allusions were mentioned three times or less, only two per cent occurred with a frequency of 100 or more. Since frequency of occurrence is an important criterion for choosing socially valuable material to be taught, these percentages probably show that very few of the allusions occur frequently enough to justify their emphasis in a teaching program.

Space will not permit the inclusion of

the 2,490 different science allusions with their thousands of meanings. As a sample, the ten allusions that occurred most frequently in the magazines together with their most common meanings are shown in Table I.

TABLE I

TEN MOST FREQUENT SCIENCE ALLUSIONS

Rank	Allusion Contexts	Frequency of Occurrence			Number of Meanings	
		C	A	T	C	A
1	2	3	4	5	6	7
1.	Electricity	443	109	552	64	22
	Wiring for home	34				
	Reference to home equipment		24			
	Refrigeration, methods of	21				
2.	Radio	282	193	475	45	8
	Description of, reference to home use		148			
	As a factor in commercial aviation	29				
	Description of, reference to power		24			
3.	Acid	59	370	429	17	6
	Control, of reference to tooth paste		316			
	As an element in fruit	9				
	Test for, reference to litmus paper	5				
4.	Teeth	32	369	401	2	10
	Care of, reference to patent preparations		151			
	As factors having direct influence on health		29			
	Care of, in connection with health program	26				
5.	Hair	49	311	360	4	1
	Care of, reference to patent shampoo and tonic		311			
	Care of	22				
	Function and characteristics of	20				
6.	Science	329	6	335	26	2
	As means of controlling living conditions	76				
	Principles of, discussed in religion controversy	66				
	Principles of, reference to tooth film		3			
7.	Vitamin	67	254	321	18	15
	As a factor in cereals		59			
	Source of, reference to cod-liver oil		28			
	As a health requisite	10				
8.	Germ	28	283	311	9	23
	Control of, reference to tooth paste		110			
	Control of, by household disinfectants		30			
	As organism carried by insect	6				
9.	Skin	50	245	295	18	15
	Care of, reference to patent preparations		119			
	Disorders of, as condition cleared by yeast		32			
	Care of	26				
10.	Lamp	41	237	278	10	3
	Description of, as electric household appliance		206			
	Value of, reference to ultra-violet ray		12			
	Function of, in explanation of television	5				

The following explanation will clarify the reading of Table I. Column 1 indicates the rank of each allusion. Column 2 shows the ten allusions and the three most common contexts or meanings of each allusion. Columns 3, 4 and 5 show the frequency of occurrence of the allusions and their meanings found in the content and advertisements of the magazines. The letter C in Column 3 is used to indicate the content of

the magazines. The letter A in Column 4 indicates the advertisements. The letter T in Column 5 indicates the total number of times the allusions occurred. Columns 6 and 7 show the number of different meanings for each allusion found in the content and advertisements of the magazines. For example, the allusion "electricity" may be read in the following manner. This term, ranked first, occurred 443 times in the content, 109 times in the advertisements, and had a total frequency of 552. It had 64 different meanings in the content and 22 meanings in the advertisements. The most common meaning, "wiring for the home," occurred 34 times in the content of the magazines. The next meaning, "reference to home equipment," occurred 24 times in the advertisements. The last meaning, "refrigeration, methods of," was found 21 times in the content of the magazines.

A more definite idea of the allusions may be obtained from the following discussion of those which appear in Table I. All of these ten allusions except "skin" and "lamp" occurred 300 times or more.

The allusion "electricity" in addition to being the most frequently mentioned allusion also had 64 meanings in the content, the greatest number of meanings for any allusion. The most frequent meaning, "wiring for the home," occurred 34 times in the content, which is 8 per cent of 443, the total frequency of the allusion in the content.

The allusion "radio" is second in rank order of the number of meanings as well as second in frequency of occurrence. The meaning, "description of, reference to home use," occurred 148 times in the advertisements. This is 77 per cent of the total occurrence in the advertisements.

A summary of the remaining allusions shown in Table I shows several important facts. The important meanings of "hair" and "teeth" are concerned with "care of, reference to patent preparations." This meaning for "hair" occurred 311 times or 100 per cent of the total. For "teeth" it occurred 151 times or 51 per cent of the total. The most common meaning for "vitamin" is "as a factor in cereals." This is 23 per cent of the total frequency of the term "vitamin." Another significant meaning is "as a vital factor in vegetables." A consideration of the allusion "skin" shows that the important meaning, "care of, reference to patent preparations," occurred 119 times which is 49 per cent of the total.

It would seem that since such allusions as "teeth," "hair," "vitamin," "germ," and "skin" occur so frequently in advertisements, definite provision should be made for teaching the truth or falsity of claims made for them. To be able to detect erroneous ideas concerning scientific terms is quite as important as knowing many facts of science.

The discovery of the contexts in which a given allusion occurs is important in that when an allusion is taught the context constitutes the important thing to teach. Such knowledge about each allusion will make it possible to include in the teaching of science the ideas and meanings of the most use in intelligently interpreting the science allusions as they are most commonly read. It would be impractical as well as impossible to teach every meaning of every allusion met in ordinary reading. Considering the criterion of frequency, it may be assumed that the most important context to teach about each allusion is that context which occurs most frequently.

Examination of the data reveals that the number of contexts associated with the allusions in the content of the magazines ranges from 64 to 1, that only a few allusions have many meanings, and that the majority of the allusions have only one meaning. A further examination reveals that 926 allusions or 39 per cent have more than one meaning, while 1,426 allusions or 61 per cent of the total have but one meaning.

The greatest number of allusions in advertisements have only one context, while

only 1 per cent of the total number of allusions have more than 10 contexts.

The most frequently mentioned allusions have the greatest number of contexts. It is further evident that while 43 per cent of the allusions in the content have more than ten contexts, only seven per cent of the advertisement allusions have more than ten contexts. This may be expected because the nature of advertisements may not lend itself to a great variety of meanings.

A general overview of the contexts of the 100 most common allusions to science shows that the greater majority of the contexts have reference either to health, food elements related to health, or household appliances. It is apparent, therefore, that the meanings of the allusions are associated in general with the application of science to the improvement of man's home environment, rather than to any technical discussion involving the term.

Persistency is a second important criterion for judging the importance of the allusions. It is therefore important to note the persistency of the allusions to science over the ten-year period. It is significant that of the 448 allusions found in the advertisements only seven per cent or 32 allusions are totally persistent over the period. Only 20 allusions, or one per cent of the entire number of allusions occurring in the content of the magazines, are totally persistent over the period. Because the advertisements contain materials advertising such articles as tooth-paste, cereals, and antiseptic preparations, it is reasonable to expect the advertisement section to contain more persistent allusions than the content section of the magazines.

The data show that only 48 of the 100 most common science allusions persist throughout the ten years of the period analyzed. Seventeen allusions occur in nine of the ten years; twelve occur in eight of the ten years; thirteen occur in seven of the ten years; nine occur in six of the ten years; while only one allusion, "insulin," occurs in five of the ten years. It is evident that the most frequently occurring allusions are also the most persistent allusions and that relatively few allusions of the total number persist over a number of years.

The evidence presented in this discussion leads to the following conclusions concerning the allusions to science and their contexts occurring most frequently in commonly read and apparently desirable magazines covering a ten-year period:

A very small number of allusions are mentioned with great frequency, while a great number of allusions are mentioned but once. Only two per cent of the allusions occur 100 times and over, while 41 per cent of the allusions occur three times or less.

Very few allusions are persistent over the ten-year period; however, the most frequently mentioned allusions are also the most persistent allusions. Fifty allusions, or two per cent of the 2,490 allusions, are persistent.

The majority of the allusions to science have relatively few contexts; the allusions having the greatest number of contexts are among the most frequent allusions.

In general, the most important contexts of the important allusions to science are concerned with personal health, food elements in relation to health, and household appliances.

It may be concluded that the contexts of allusions in the content of the magazines contribute more evidence of change in meaning over the ten-year period than do contexts of allusions occurring in advertisements of the magazines.

It is recommended that teachers building a science program with instruction aimed at an intelligent interpretation of science allusions commonly met in reading should consider the 100 most common allusions as being basically important.

Students doing further research concerning allusions to science in magazines will find valuable the information that, of the four types of magazines, the literary type ranks first in frequency of occurrence of allusions, followed in order by the home, the story, and child types.

RECENT DEVELOPMENTS IN ELEMENTARY SCIENCE IN AUSTIN

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How elementary science became a definitely recognized part of our grade-school curriculum is a story of small interest when compared to the developments in the course itself since its inauguration. Difficulties in establishing continuity of the science program to avoid conflicts with and duplication of the courses in the junior and senior high schools caused the making of a definite course of study, for the grade work. The guiding principles for this are found in the Introduction of Part I of *Tentative Course of Study for a Continuous, Integrated Program in Science in Austin.* The objectives of the course, selection of content, organization and grade placement of materials, and methods are fully discussed in this same publication. Since its publication early in 1933, many developments in other schools, new supplemental materials of various kinds have become available, which with our own experience have suggested new procedures which are improving our results.

A brief résumé of our most urgent problems will be more than sufficient to show why plans successful in other situations could not be most successfully used in our situation. It is true that our worst handicap is speedily being eliminated but until the current year this was indeed a burden. As yet this is generally an unsolved problem, this problem of finding adequately trained teachers. Until colleges revise their programs for teacher-training, we shall continue to tutor small classes for these new teachers of elementary science. Even the high-rating science "majors" from most colleges and universities find themselves handicapped by lack of general acquaintance with all major fields of science. And we cannot hope that elementary science will be acceptable for nor can it be included in programs of all schools until all teachers are prepared for this field of instruction. Through our efforts, there is at present the development of a general science course for college students who are preparing for teaching, and plans are being made for this to be a requirement for certification of all elementary teachers.

Then various administrative difficulties of scheduling the science classes as a regular and definite part of the program resulted in irregularities in our own system. In some elementary schools alternation of the science classes with physical training classes resulted in classes of boys and classes of girl. While this may not seem to be an important fact in classroom methods and even in subject-matter content, one needs only to try it once to be convinced. This is especially evident in some units of work such as electricity, social life among animals, machines, plant life of our neighborhood, etc.

The incoming transfer-students must of necessity be classified with others of the same grade level in the three R's regardless of the fact that practically none of these children from out of town have had any science training. Even the simple experiences gained in the lower levels make quite a difference in the attitude and insight of these children from other school systems. For we do not emphasize the acquiring of many facts in the lower grades: our main purpose is to acquaint the child with his surroundings, and to let him understand how man has improved or made use of the environment.

The modified platoon system which exists in our schools has many advantages for the regular traditional subjects and for science classes, too; but we have found a constant tendency on the part of students to "pigeon-

hole" their experiences. This requires the teacher to be constantly alert to the possibilities for correlating her science activities with other school activities of her students. We find that the new inexperienced teachers in our schools feel this handicap more than the older ones. This administrative difficulty is unavoidable, for almost every system has some addition or change in its faculty each year.

Sufficient references and suitable reading materials are available only if there are ample funds accessible for purchasing them and if there is sufficient time allowed for their use. As we now have a wide range of materials to select from, only the time and the money questions remain to be solved. These problems of money and time are easy to state but actually difficult to solve. In the depression days of course, money was not to be expended upon "frills and fads." And now that we are beginning to turn the long-looked-for corner (around which the mythical prosperity has so long remained inaccessible), the increased enrolment, renewal of building repairs, etc., have absorbed the funds which might have been accessible for books and reading materials.

And while some improvements in our science program have been achieved through provisions for the problems just mentioned, our more significant activities have been and are centered on the inadequacies revealed through the use of our planned course of study. It is quite evident that a definite, scheduled and *planned* mass of materials is actually a hindrance in best classroom teaching for the limitations of its scope cannot fail to mechanize the activities of the class. This has an ever present danger for making the average teacher "course-of-study-bound." While close integration of all levels is possible only through the consistent developments in each lower level, we are finding that our primary concept of teaching subject-matter to our students often fails to develop the students themselves. And we are again faced with the basic question, *how* can the student be taught? Our definite course of study failed to provide flexibility for various situations in our community. In any school system, the student groups vary in interests, ability, environmental possibilities and experiences. We had the heterogenous melting-pot of the slum area following the same course of study presented the children of university faculty members. Naturally the results from these two groups would never be anywhere near the same level, yet teachers following a set course of study must ignore special interests of certain groups in the name of "keeping up with the required course." Our biggest problem is that last-named one, the course of study, or what to teach and how it may best be taught. Another difficulty experienced in using a course of study is that the present rapid increase in supplemental materials of all kinds makes even a three-year-old guide in science classes (even though they are elementary) quite obsolete. And the busy classroom teacher has neither the time nor the energy to evaluate adequately the fine materials that she could utilize in her overcrowded classes. Hence a more comprehensive and annotated bibliography with suggestions for use in various parts of the materials likely to be taught is needed. Additions to this should be made and filed in a convenient place for her use. Condensed directions for experiments, lists of materials which are needed for each, may seem unnecessary, but present conditions are such that we cannot ignore this urgent need of busy teachers.

These problems have been given more attention recently than many others which we face. Inadequate training for teachers is being reduced through regular classes during which demonstrations and concise explanations of the main essentials of basic units are given, usually by the supervisor or by one of the experienced teachers. Specific references to the science teachers' library supplement these class lessons. Opportunity to ask questions and to manipu-

late demonstrative apparatus follows each class lesson. Our teachers do not have to be required to attend these lessons. Often they request more help than we have time to give. At sectional faculty meetings informal exchange of teacher experiences has proved invaluable. However, we have learned that many teachers with experience lack much fundamental training. Through a critical study of our entire science program we have improved our entire staff through considerations and study for revisions of our present course. We are cooperating with the statewide curriculum revision movement, thus began our activities with this in view. The present result is that we have listed what we conceive to be a complete list of science generalizations which are basic for a general public-school program of science beginning in the primary school and extending through the high school. These are arranged into four main areas to facilitate references to these though it is evident that some classification would not be absolute due to overlapping of scientific fields themselves. Actual selection of and evaluation of these generalizations required a restatement of and determination of a definite point of view regarding the aims of all science teaching. For a general aim we accepted for our guiding principle "to provide for an increasingly adequate understanding of and creative participation in contemporary society and the social processes."[1] Generalizations were collected from many sources, duplications eliminated, some were restated for clarity, and the following questions were then critically applied to the final results:

1. Does this list of concepts include what you consider as the *essentials* in the science fields?
2. Have too many generalizations been included, if so which should be omitted?
3. Consider the wording of these concepts. How would you reword any of them for sake of clarity, accuracy, or completeness?
4. In referring to these concepts do you prefer them to be grouped as to subject fields, or do you prefer them to be arranged miscellaneously?
5. To avoid subject-matter attitudes how may these concepts be arranged for convenience for reference?
6. In your teaching do you include materials which do not tend to develop these generalizations?
7. In a consistent, integrated program should we expect each student to have acquaintance with all of these concepts? If not, which concepts are more desirable?

In general, this activity has served to renew the broad overview which we should always have toward our particular field. In many of our teachers, this study of generalizations established a foundation that is helping develop classroom activities which apply to life experiences of the students in such a manner that a more scientific attitude is evident in their behavior. As a teacher-training aid, the study of curriculum revision has been a real help in our groups.

The administrative difficulties have presented a variety of needs to us. We have adapted classroom activities to suit needs and interests of boys and girls as indicated by the groups themselves. The transfer students have been given individual help as often as possible and suggested library readings suitable for them are posted for their guidance. To prevent "pigeon-holing" of science experience, teachers are urged to correlate all their science activities with some other subject or subjects. A competitive race for getting more correlation than others is proving quite a motive for cooperative associations of teachers in all levels of the grade schools. To provide available and suitable materials for the majority of our students, and this usually means the underprivileged children, we assembled a series of workbooks for each of the grades having definite science classes. These are really more than workbooks, for they contain short summary stories of basic units, suggestions for experiments and other things the child can do toward observing the scientific principles underlying the unit

[1] W. A. Stigler, *Handbook for Curriculum Development*, Texas State Department of Education, February, 1936.

itself, review and thought questions, vocabulary lists of words new to the child's reading level, some self-testing exercises, and plenty of space for him to make notations of additional materials they can include in his particular group.

To counteract the limitation of the scope of the course and to make possible more flexibility, we have delineated certain units of the course of study as basic or required. The approximate time limit for these occupies about one half the time allowed for science classes in the third, fourth, and fifth grades. The remainder of the time may be utilized in developing special interests of the students along any line, always keeping the major scientific concepts in mind as the desired outcomes to be derived, and always endeavoring to develop these along the line of scientific attitudes. To make these two last be functional in the life of the individual we are approaching this selective teaching in several ways. At present we are convinced that our greatest problem is, not WHAT we teach but HOW it is taught. Accordingly we are applying constantly our best efforts toward the development of the desired scientific attitude and toward the ability of using the scientific method in every-day life of the individual. We heartily approve any method which makes utilization either for pleasure or for profit possible for each individual. It is well known that possession of facts does not indicate their usefulness to the owner. And so, we are concerned with *how* and not *what* that our students learn regarding experiences in the science laboratory.

Through exchanges we are enabled to progress upon the successes of our pioneer leaders in teaching young children to understand and to participate in present-day society. The scientific background cannot be ignored for only through adequate understanding of this background can successful participation be enjoyed by the individual. And we, in Austin, are experimenting to learn more effective ways of developing students toward a more thorough understanding of our scientific age.

CONTRIBUTION OF NATURAL HISTORY TO HEALTH EDUCATION*

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Health education is one subdivision or aspect of a large and rather novel undertaking on the part of the human race: the effort to utilize scientific knowledge and method to improve our success in living. Success means many things to many men, but to all it must mean at the very least two things: first, to stay alive, to the end of a reasonable life span; and, second, to enrich life, for ourselves and others. Men have always sought these goals, but only recently through refined knowledge, through methods of observation and experiment.

* Presented at the annual meeting of the National Council on Elementary Science, New Orleans, February, 1937.

Natural history emphasizes observation under field conditions, as contrasted with laboratory study. The laboratory has made in recent times a rich contribution to our skill and knowledge of how to manage our lives to secure welfare. The contributions of natural history in our day and generation are yet to be clearly recognized. Yet the natural history method is far older than the laboratory, as fields, streams, forests are older than houses and pavements.

Much recent work in elementary science and general science, in high school biology and physiology, provides rich sources of contributions to health education materials from laboratory science. Therefore, I

shall pass these with only a mention of the interest of children in the structure of the body as shown by various excellent devices; in the wonderland of bacteriology and its application in communicable disease control; in good nutrition as a miracle-worker, beautifully demonstrated on laboratory animals; in the tools of modern medicine, the X-ray, endocrine medication, surgery, laboratory diagnostic aids, immunization procedures. Not less thrilling material is to be had from the dramatic public health measures which wipe out or reduce to insignificance such plagues as cholera, hookworm, typhoid, small-pox, diphtheria, yellow fever. These are the great beneficent human adventures of our generation, no less stirring to the spirit than the marvels of the radio or of the airplane. These achievements need to be taught children, not only that they may utilize their knowledge as individuals and as citizens, but that they may share in the spirit of these amazing and beneficent advances. Otherwise we leave our pupils culturally illiterate, lagging far behind current knowledge and skill, living in the darkness and bondage of superstition, rather than in the light of rational knowledge and applied science.

This teaching, while still only begun, is at least well begun, and its values generally appreciated, even though not fully realized. But the aspect of science teaching to which I wish to direct your thought is not often considered in relation to health education, or to the advancement of general human welfare. This is the study, by first-hand contact and observation, of the living world, and of the Universe which has produced and sustains it. Because the Universe is a universe, and living things are more alike than they are different, almost any samples of reality will serve us and our pupils for this type of work.

Books, pictures, laboratory demonstrations are nothing but introductions, valuable only as they make contact with real things more significant to us. From the standpoint of natural history, they sink into their proper places as aids to clearer seeing, to sharper perceptions of all sorts.

Little children, as they learn to talk, are endlessly eager for names, for labels, for the sense-perceptual objects which surround them. "What's that? and that?" goes on all day long. We know that only by this naming does a child get intellectual command of the multitudinous impressions which throng in upon him. Naming is a first step toward generalization, discrimination, perception of likeness and difference; we know this well enough within the circle of home, but fail to follow our children's eager exploring feet, as the toddler, becoming the runabout and widening his geographic range, increases thereby his store of things-to-be-named, classified, related to other things. It is "too much trouble," or "we don't know the names ourselves," or, most often, there are so many important books and pictures for the six-year-old to look at!

So, in an effort to give him the human gift of symbolic thinking, we spend all our energy and his on interpretation and production of written symbols, missing the obvious fact that a symbol which has no content, a label which labels nothing, are useless things, burdensome excess baggage.

These dangers of verbalism are familiar to all modern teachers, and much has been done to guard against them. But the thing which science teachers have failed to recognize is that this failure to keep a child's inintellectual life directed to the world of objects around him has a direct and deplorable effect on his mental integrity. His world becomes manifold, not unified; and he is no longer at home in it. This failure to maintain through early school life the direct and unquestioning relationship to reality which is so characteristic of young children is a loss in welfare which is serious, diffcult to repair.

The two-year-old who stretched out his hand to the sky, crying gleefully, "John's

Moon!" had the right idea. It *is* John's moon, and John's sun, and John's whole round earth and all the starry frame of the Heavens, and all the fascinating company of bird and beast and tree and flower and rock and sand and water and rain and dew; not exclusively his, to be sure, but his none the less. And much more joyfully, certainly his, as he takes possession of the names, the kinds, of all these things; as he learns their feel, their heft, their look and smell and taste.

Modern scientists have given us tools for modifying ourselves and our environment, beyond any ever possessed by man before. We have quite naturally thought more of what we could do to Nature, than of what Nature eternally and beneficently does for us. Even these tools are nature's own contribution, not some supernatural gift to us. The only sound basis for mental integrity, for human well-being and happiness, is this recognition of our kinship with nature, an enthusiasm for knowledge of her endlessly varied and fascinating forms, and a firm confidence in the dependableness and the beneficence of the world of Reality.

This interest, this feeling of kinship, this secure relationship, can only be obtained through establishing and maintaining a lifelong contact with the world of things-as-they-are. Such contact affords the greatest possible assurance of organismal integrity, which is basic to successful human living. It is an aspect of health maintenance for which there is no satisfactory substitute. After all, why keep alive, if life means to us only ceaseless conflicts, struggles, repressions? When we feel ourselves alien to our world, we have lost the springs of joy, of hope, of courage.

Does this seem a great claim to make for simple knowledge and faithful devotion to the study of this good earth? Some of the best evidence of the soundness of this claim can be had, it seems to me, from the lives of great students of the living world. We have no record of cynical, world-weary naturalists. Whenever personal griefs came upon them, they had sure refuge for their spirits in the familiar beauties of the natural order.

If health education is to be taken in its best sense, enriching life as well as prolonging it, no one can make so rich and durable a contribution to this end as the enthusiastic and competent naturalist-teacher. William Cullen Bryant expressed our potential service better than most of us can ever hope to do, when he wrote:

> "To him who in the love of Nature holds
> Communion with her visible forms,
> She speaks a various language;
>
> . . . .
>
> And charms away his sadness
> Ere he is aware."

SCIENCE MATERIALS AND EQUIPMENT FOR THE ELEMENTARY-SCHOOL PROGRAM

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The reorganization of the science curriculum in our schools presents a number of vital problems and not the least among them is the question of materials for teaching purposes. The high school and the junior high schools have succeeded in getting science laboratories, equipment and supplies. The science room is gradually becoming a part of the standard plans for the new elementary schools, and rooms in the older buildings are being adapted for science teaching. Assuming that we have an adequate course of study, teachers with some background and training in science and an adequate room, it is imperative that materials and necessary equipment are available. Unless we in some way provide plants and animals for the biological units

and simple apparatus for the physical phases of the science we are dealing with mere words and our science work will be replaced by other subject matter in the schools.

Imagine a teacher attempting to have the pupils understand the principles involved in the study of the electric bell without making or demonstrating the electric magnet, the battery, and the wires for conducting the current. What a dull procedure it would be. On the other hand, consider the opportunities for experiences when time is spent experimenting with an ordinary door bell. The electromagnet, the insulating, the conductors offer problems for experimenting and demonstrating.

Consider the experience gained by the child when studying about steam with a miniature steam engine operating before him. The whistle, the exhaust, the fly-wheel, all help to make worthwhile activities possible. If toys or standard equipment are not available, a home-made device can be used to illustrate the principle. Can you imagine a farm unit without the farm building or the devices used in doing the work on a farm? What a dull farm it would be for children who have never had any experiences in our rural areas.

For both the biological and physical aspects of our science we need certain equipment to help pupils understand the principles involved.

Research studies have shown us that elementary school pupils are interested in both physical and biological aspects of science. We have provided subject matter and activities for both aspects of the science in our courses of study. It seems, therefore, to be essential that we consider seriously the problem of adequate equipment.

For our consideration I have grouped the materials which I shall discuss under the following headings: (1) materials and equipment obtained locally; (2) home-made or school-made apparatus; (3) toys; (4) equipment and supplies purchased; (5) science library.

MATERIAL AND EQUIPMENT OBTAINED LOCALLY

For the units dealing with seeds, fruits, vegetables, trees, wood, pond life, weeds, wild flowers, specimens of one kind or another are available or better still short excursions will allow the children to see the specimens in their natural habitat.

Even for material in our immediate environment it is essential to have prepared specimens of such items as birds, mammals and insects. This statement is made with the understanding that live materials are to be used whenever it is possible and whenever their use in the schoolroom is practicable. If any of the larger animals are to be taken in the classroom it should be to meet a real need in connection with definitely made plans by the teachers and pupils.

The reaction of teachers as well as my own experience indicates that the larger animals such as chickens and rabbits should not be kept in the classroom for an indefinite time. It is better practice to dispose of them when the study has been completed. Otherwise, the animals do not continue to thrive, due to improper living conditions, and the results are unpleasant experiences for the pupils.

There are certain types of materials for the physical sciences which can be obtained locally. Often scrap pieces of lumber or sheet metal can be obtained to perform simple experiments. Electrical supplies, sockets, bulbs, wire, dry cells and switches can be obtained from the local dealer. Discarded electrical devices can often be obtained and utilized for experiments. An old rheostat, electric toaster, hot plate and the like are items of interest to the child and offer opportunities for exploration.

However, one must guard against the tendency to accumulate "junk" in the classroom. An item which cannot be definitely used for a unit should be discarded. The

remaining materials should be classified and stored when not in use.

HOME-MADE OR SCHOOL-MADE APPARATUS

The home-made apparatus serves a real need in illustrating principles of science. Such devices make a strong appeal to the children. I have known cases where the devices made by the child were more appreciated than the finely polished purchased apparatus.

About two or three years ago two boys were building a telegraph line from our house to the neighbor's home on the next lot. The boys were using devices which they had made in their basement work shop. I happened to have a regulation size Morse instrument in my study and it occurred to me the boys might prefer to use it. I offered them the device which was accepted and I supposed would serve their needs. The next day to my surprise I discovered my expensive apparatus had been discarded for the more crudely fashioned sets. When I inquired why my device had been discarded the reply was "It is all right but we like our sets better."

For the past five or six years I have been attempting to determine what devices can be made and used to illustrate principles of science in grades one to six. The cost and availability of materials, the time for construction and the value as a teaching device have been considered in making up my list.

Here are some of the devices which can be profitably constructed for science teaching.

1. A type of steam turbine made from a tin can with tightly fitting lid, a wire harness and a small propeller or fan wheel
2. The American and the Dutch type of windmills (see *The Instructor,* March, 1935, page 46)
3. The shocking machine—making use of the induction coil
4. Water wheels of various types
5. Telegraph sets
6. Electric questioners
7. Sand loaders
8. Hour glass
9. Pin-hole camera
10. Cartesian diver
11. The buzzer
12. The magic theater
13. Electric motor

There are also simple experiments making use of such materials as glass, iron filings, magnets, paper clips, bolts, screws, yardsticks, *etcetera.* The home-made apparatus and simple experiments are most stimulating and lead to considerable exploration.

TOYS

As a part of the study of equipment it has been attempted to find toys that illustrate phases of the science generalizations which we include in our science program for the elementary school. I have used two criteria in making my selection, namely, (1) They must be relatively inexpensive, and (2) They must illustrate adequately one or more principles of science.

For the farm unit, the team of horses hitched to the farm wagon, the modern tractor, and the threshing machine are helpful. I find many of our freshman in college do not identify the threshing machine as it is used on the farm today. The pile-driver, and the steam shovel are familiar devices to city children and these toys are most interesting and helpful for science units.

Airplanes, freighters, electric trains and dump trucks add much to any unit on transportation.

Recently the microscope, the telescope, and the fifty-cent camera, have made their appearance and are gradually getting into the hands of our children. Whether or not these items are toys, they offer opportunity for exploration into the fields of science.

We need not ask the administrators immediately to spend large sums of money for toys. First make use of toys available from the homes. Then as the need warrants add certain toys which you are convinced will be used.

A supervisor of science in one of the largest cities of Texas, after visiting my laboratory returned to his school system and immediately made available for certain units some of these toys. He is enthusiastic about the results.

EQUIPMENT AND SUPPLIES PURCHASED

There are certain materials and equipment which are difficult to obtain unless they are available in the supply cases of the science room. One can sometimes borrow or buy locally, but there are certain materials which are difficult to obtain in the ordinary stores.

One day I needed a piece of rubber dam. I almost reversed the order of the words before I succeeded in getting the material. I spent several hours shopping for it and finally decided to order it direct from a school supply company. For the cost of a letter the material was delivered promptly to my office with a minimum of effort and time on my part.

The increased interest in the science program for the elementary school made it imperative to consider the problem of what items should be purchased. About 1928 I met a young man, an officer in one of the firms supplying science equipment to schools, who was willing to consider our problems for the elementary school. Accordingly an attempt was made to select and adapt materials and apparatus to meet the needs of children in the grades. After trying out a long list of items the equipment listed below was suggested. This list should be considered as a minimum for a science program. Other items can easily be added as funds are available and as the local needs warrant. A list such as this should last almost indefinitely and with the cost distributed over a period of years it is a meager sum.

List of Supplies and Equipment for Elementary Science—Grades I to VI

First Grade

12	Rubber Balloons, small
6	Receptacles, socket for miniature lamp
6	Miniature Incandescent Lamps, 2.5 volts
1	Switch, single point lever switch
1 lb.	Annunciator Wire, copper, D.C.C. No. 18

Second Grade

1	Cartesian Diver
1	Siphon, arms 20 cm. and 30 cm. long
1	Thermometer, standard, −20 degrees to 120 degrees F.
1 sq. ft.	Rubber Dam
1	Bar Magnet, rectangular, polished steel, 15 × 1.9 × 0.7 cm.
1	Iron Filings, ¼ pound carton
12	Candles, paraffin, twelves
3 ft.	Rubber Tubing, white, ¼″ dia., 1/16″ wall

Third Grade

1	Thermometer, standard, −20 degrees to 120 degrees F.
1	Horseshoe Magnet, 7.5 cm. long
1	Iron Filings, ¼ lb. carton
1	Friction Rod, glass, solid, 30 × 1.3 cm.
1	Friction Rod, vulcanite, 25 × 1.3 cm.
1	Silk Pad, 20 × 20 cm.
1	Flannel Pad, 20 × 20 cm.
1	Whistle, glass with piston, 25 cm. long
1	Prism, equilateral, 25 × 75 mm.
1	Reading Glass, lens 2″ in dia.

Fourth Grade

1	Universal Sun Dial, unmounted, for use in 40 degree latitudes
1	Gyroscope, simple form, with 5 cm. disk
1	Model Water Wheel, showing undershot, overshot and breast types
1	Pump, small hand type, 15 cm. long
12	Rubber Balloons, small
1	Compass, 25 mm. dia.
6	Color Tops, disk 4 cm. in dia.
12	Pipes, clay

Fifth Grade

2	Single Pulleys, bakelite, 5 cm. in dia.
1	Ball Ring, to show expansion due to heat
1	Unequal Expansion Bar, 30 cm. long
1	Convection Apparatus, with glass slides and chimneys
1 sht.	Touch Paper, 20 × 25 cm.
1	Radiometer, one set of vanes
12	Candles, paraffin, twelves
1	Spring Balance, double scale, capacity 64 oz. in 1 oz. div. and 2,000 g. div.
1	Support Rod, 13 mm. dia., 125 cm. long
1	Right Angle Clamp, with two V. openings, for 13 mm. rods
1	Lamp, alcohol, round, glass 4 oz.

1	Support, iron, tripod base, legs 4″, rod 5/16″ × 18″
12	Test Tubes, 5″ × 5/8″
1	Washington School Collection of Rocks and Minerals, including 20 rocks and 20 minerals, all labeled in compact display case
3	Dishes, Petri, double culture dishes, 50 mm. dia.
1 X 4 oz.	Cotton, Absorbent

Sixth Grade

1	Steam Engine and Boiler, for classroom demonstration, 25 cm. × 20 cm.
1	Steam Engine Model, locomotive type, large size, complete model
1	Dry Cell (dry battery), standard size, 1.5 volts, 25 amperes on short circuit
1	Battery Motor, little hustler, mounted on base
1	Telegraph Set, complete sending and receiving
1	Telephone Receiver, demonstration form, completely dissectible, resistance 75 ohms
1	Telephone transmitter, commercial type
1	Bell, electric, dia. of bell 2½″
1 lb.	Annunciator Wire, copper, D.C.C. No. 18

SCIENCE LIBRARY

Along with the materials and equipment one needs to consider the use and source of reading materials. The number of books published in the past two years is surprising when one considers the financial condition of our country. These books cover a wide range of subject matter and interest. The writer has published elsewhere lists of new science books classified with brief comments.[1]

There will be some modification to meet local situations but a definite plan worked out on the basis of minimum requirements will prove most helpful in beginning to arrange the science equipment and materials.

A comprehensive plan, too, has the advantage of supporting a purchasing budget over a period of several years.

A STUDY IN THE ESTABLISHMENT OF A NORM IN SCIENTIFIC ATTITUDES AND ABILITIES AMONG NINTH-YEAR PUPILS

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In the fall of 1934, the writer attempted to determine the extent to which the members of our entering classes practiced certain scientific attitudes or possessed certain abilities which we ordinarily associate with scientific attitudes.

These pupils came to us from the elementary schools and it seemed safe to assume that if we could detect any of these traits among certain groups of them selected for the experiment, their presence and degree of development would be the result of good or poor training in the elementary school and the home.

There are many scientific attitudes and abilities now recognized. Among the many, just six were selected because these were thought to be those likely to have been somewhat developed in the school and the home. These six attitudes or abilities were: (1) Honesty, (2) Good Habits of Work, (3) Initiative, (4) Dependability, (5) Openmindedness, and (6) Group Courtesy and Cooperation.

The problem for which a solution was sought was this: To what degree has the school and home training affected these ninth-year pupils so far as these six attitudes or abilities are concerned?

If the degree to which each trait had been developed could be determined, we would be able to discover and establish a

[1] Persing, Ellis C. *School Science and Mathematics* 32: 65-67, 979-997; January, December, 1932.

norm for the group of pupils with which we worked. If such a norm could be discovered, it might well be used as a basis of comparison with other norms established in other groups of the same grade or different grades. We might go further and establish a norm for all pupils of the ninth or any other year which would hold good for a period of time. With a norm established we could determine our progress in the development of our pupils along certain lines as we could build upon these norms as a basis. If the norm in any trait were low we could plan on stressing it in all of our class work. If high we could use it to advantage. If the trait appeared to be antisocial or harmful to other trait development we could counteract it.

Since children differ widely in their physical, mental, moral and emotional attributes as a result of hereditary and environmental influences, it follows that there will be a wide variation in the degree with which each child acts or reacts to stimuli designed to develop any or all of these traits.

Accordingly, five stages or steps were artificially selected in the development or expression of each ability or attitude. These steps were based largely upon experience. They are not graded accurately. Indeed, it seems to us that such grading is impossible at the present stage of investigation of attitudes. Yet, a beginning must be made in every problem, if it is to be solved. This is a beginning and a very meagre one.

The stages or steps within each attitude or ability are indicated below.

A. HONESTY:

1. Cheats in a test in a brazen way before your very eyes. Appears to have no sense of what it means to play unfairly.
2. Cheats if given the least opportunity, as when the teacher's back is turned or he looks the other way.
3. Will bear watching. Rather neutral. Shows no tendency to cheat but on the other hand never shows by his or her actions that he would not cheat if given the opportunity.
4. Will not cheat unless openly encouraged to do so, as when the teacher talks to a fellow teacher with back turned or momentarily leaves the room.
5. Will not cheat under any circumstances. Uses influence against it. Absolutely honest so far as observation will show.

(Note: There are other ways of showing honesty or dishonesty, of course. These are to be considered if and when they arise as individual cases.)

B. OPENMINDEDNESS:

1. Will "throw a fit" if the teacher accidentally drops a looking glass and breaks it. Is sure that bad luck will surely come to the teacher or to any one who drops and breaks a mirror.
2. He would not like to drop a mirror himself, but shows no concern when another drops one. He is not thoroughly convinced that one will or will not have bad luck by dropping a mirror.
3. Is quite convinced and confirmed in his own beliefs but will apparently give in under the weight of arguments.
4. Shows that he realizes that his ground is untenable and accepts another opinion because the majority are against him and therefore they must be right. Accepts consensus of opinion.
5. Openly states that he willingly accepts the other idea because it seems more reasonable than his own or is backed up by conclusive evidence.

(Note: The same idea applies here as in the note above under A.)

C. GOOD HABITS OF WORK:

1. Is slovenly in appearance, actions, does poor and careless work, will never follow directions. Written work soiled and tattered. Posture bad.
2. Is capable of doing good work under pressure, but relapses the instant the pressure is removed. Good actions never become habitual.
3. Speech, posture, written work, attention, all classroom activities are "up and down." Good sometimes, but next time poor to bad. Erratic.
4. Shows consistent and sustained good work with encouragement with but occasional derelictions.
5. Work always done neatly, done on time, generally correctly done, with good posture, good English, neat in appearance. Good all through.

D. DEPENDABILITY:

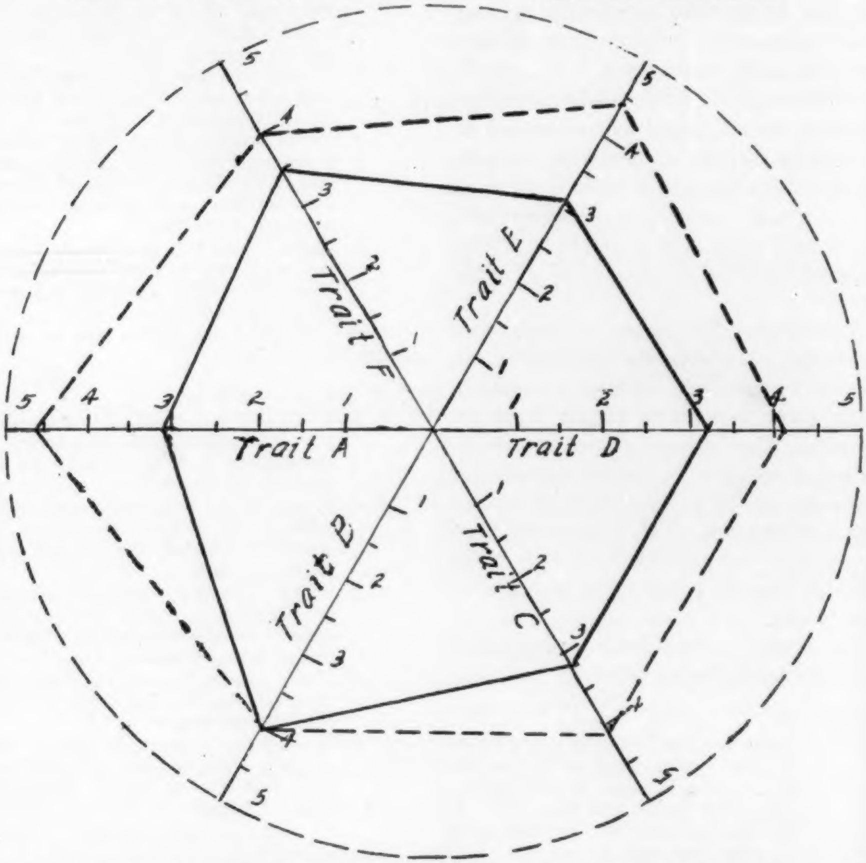
1. Never does anything he can get out of doing.
2. Will do assigned work under pressure.
3. Does assigned work fairly regularly when encouraged to do so.

4. Does assigned work regularly with no "ands" and "buts" and "ifs."
5. Does work assigned in fine shape, but does more work than is assigned. Always reacts to responsibility in a handsome manner.

(Note: same as under A.)

E. INITIATIVE:
1. Sits stolidly in the class, never volunteers to do anything. Unless forced to do so, never adds anything to the progress of the work.
2. Sits quietly in class, listens attentively, never reacts unless called upon and then answers fairly well.
3. Volunteers to contribute to the recitation under encouragement.
4. Volunteers on all occasions and is always ready to act at the "drop of the hat." Shows some originality. Is a good hand raiser.
5. Is over-active along all lines. When properly directed—a help. When improperly directed—a pest.

F. GROUP COURTESY AND COOPERATION:
1. Is distinctly antisocial, sullen and uncommunicative.
2. Does things for the common good (class work) under protest (words and acts).
3. Shows no antisocial tendencies, nor, on the other hand, positive cooperative tendencies. Told to do a thing and does it, but the spirit is neutral.
4. Cooperates occasionally or offers suggestions. Shows some tendency to give others preference. Is fully amenable to suggestions, encouragement.



GRAPH 1.—Showing norms for 210 boys (solid line) and 76 girls (broken line) in each of six traits: A—Honesty, B—Openmindedness, C—Good Habits of Work, D—Dependability, E—Initiative, and F—Group Courtesy and Cooperation. No. 1 position is rated as 20 per cent and No. 5 position as 100 per cent.

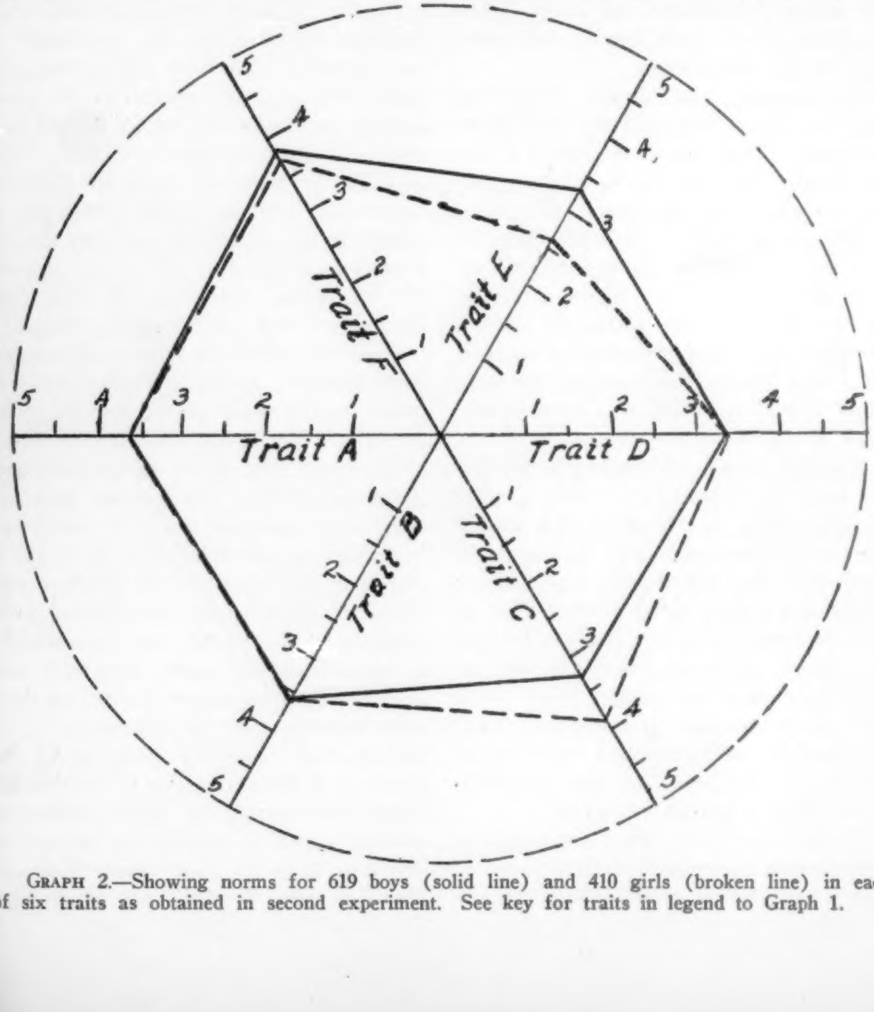
5. Volunteers at all times to aid teacher or classmates. Shows fine spirit. Always courteous to others, going more than halfway in deferring to other pupils.

The half dozen teachers who tried out the experiment were carefully selected and normal classes were used. Unfortunately, it was impossible to select the boys and girls so as to have equal-sized groups. Teachers were requested to make as many observations as possible over a period of about six weeks. Some 2600 observations were made on 210 boys and 76 girls. The results were objectified in Graph 1 as follows: Each numbered point in each diverging line corresponds to the five numbered steps in each attitude or trait.

If we assume that the No. 1 position on each diverging line is the lowest and is rated as 20 per cent of perfection, then the norm of the boys in honesty is 60 per cent and the girls about 90 per cent. Both boys and girls coincide in openmindedness at about 80 per cent.

These results may be or may not be significant. The figures are correct. The question is: Have we established a norm for boys and girls in these attributes?

Graph 2 shows a second norm established as the result of an experiment with 619 boys and 410 girls during the fall of 1935. To get these results 12,825 observations were made. This second graph when compared with Graph 1 reveals some inter-



GRAPH 2.—Showing norms for 619 boys (solid line) and 410 girls (broken line) in each of six traits as obtained in second experiment. See key for traits in legend to Graph 1.

esting results. The grades of the boys in each one of the six abilities or attitudes are somewhat higher in the second experiment and that of the girls somewhat lower. Both boys and girls have an equal degree of openmindedness although both do not rate as high in the second as in the first experiment. The girls still lead the boys in good habits of work with the same rating in both experiments. This may have been expected, but has seldom been demonstrated by actual experimentation.

Again, the girls slightly excel the boys in dependability in both experiments, while in initiative the boys excel the girls which was to have been expected, although the first experiment gave a different result. In the second experiment the boys slightly excel the girls in both honesty and group courtesy and cooperation.

It is probably true that the average ratings on a percentage basis are too high on all points. That may be accounted for on the ground that most of the teachers were women in the first experiment and inclined to favor boys while in the second one the men and women doing the experiment were about equal in number. Again, a far less number of pupils were used in the first experiment and a far less number of observations were made. Furthermore, the technique of the experiment was better understood in the second experiment.

Keeping these considerations in mind, I am bound to conclude that while a norm has been set up as a result of each experiment which may well apply to the pupils involved in that experiment, a comparison of the two graphs seems to show that no norm has been set up as a result of the two experiments taken together that has any valid importance as a guide for future work along this line. It would take many experiments, well controlled and extending over a long period of time, to obtain results upon which we may build.

On the other hand, there are evidences of tendencies towards the establishment of such a norm as one studies these two experiments. For example, since it is evident that so far as these two experiments are concerned, the girls excel the boys in good habits of work and in dependability, it should be fairly easy to establish the degree of each trait in boys and girls as a norm. Since both boys and girls are rated with the same degree of openmindedness in each separate experiment, but of different degrees in both, it follows that this is a variable as between different groups observed at different times, but runs about the same among boys and girls in the same group. Efforts to increase this trait may be made with equal emphasis with both boys and girls, if the graphs mean anything at all.

Finally, honesty, group courtesy and, perhaps, initiative may be considered as real variables. The first two undoubtedly have their greatest impetus in the home and the pupil comes to school for the first time well or poorly trained in each. The task of the school is great in changing these traits for the better. Initiative is largely an hereditary trait and may thus be classed as a variable. This may account for the great differences in this trait between the first and second experiment.

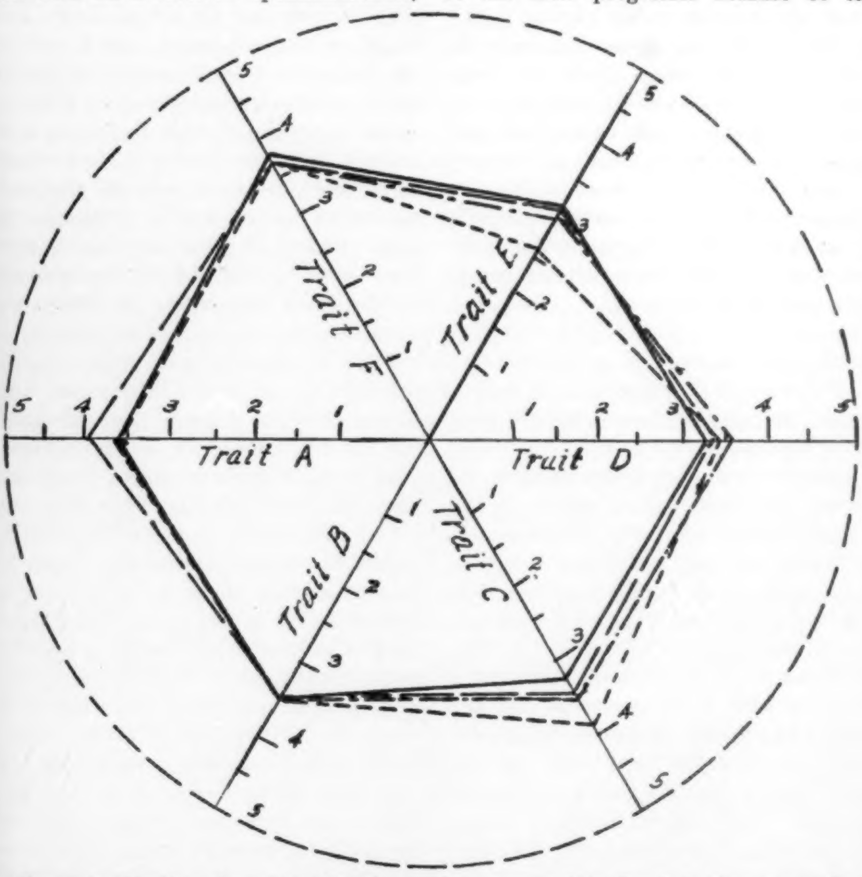
A second part of the most recent experiment follows. A second observation was made on the same pupils for the same period of time during the last four weeks of the term. The object was to determine, if possible, if there had been any improvement or advancement in any of these traits as a result of ten weeks' training. While it was assumed that all of the teachers who instructed these pupils were setting good examples in these traits and were actually trying to make the pupils frequently conscious of the advantage of developing these traits through objective illustrations (since all had been requested to do so by the principal of the school) yet it must be admitted that most of the actual teaching of these attitudes by appropriate objectification was done by their science teachers. However, with but one out of at least

four, and often six or seven, different teachers stressing these traits, certain results are discernible, as shown in Graph 3.

The black continuous line indicates the results of the experiment on the boys covering the early part of the term and is a duplication of Graph 2. The long-dash broken line is the result of the last experiment on the boys at the end of the term. The short-dash broken line is the result of the early experiment on the girls, while the dash and dot line is the result of the later experiment on the girls.

Observation of both sets of results shows: (1) that both boys and girls made a slight advance in honesty; (2) both held their own on a level in openmindedness, although slightly below the level of the first experiment of a year earlier; (3) the girls slumped slightly in good habits of work, while the boys improved; (4) both boys and girls improved in dependability; (5) the girls made a distinct improvement in initiative while the boys fell back slightly; (6) both made but slight changes in group courtesy and cooperation.

Explanations of discrepancies are legion. For example, girls are more often trained in good habits of work than boys. Under urging and penalities the boys improve, while the girls, whose work generally passes muster because of its better grade, may become inclined to let things "slide" as the term progresses because of less



Graph 3.—Showing change in traits for pupils represented in Graph 2 after ten weeks of training.

prodding by the teacher. Under initiative boys are more liable to excel in this trait. Under encouragement girls will improve, while many boys are so "pushing" in this trait as to make it a negative trait and it must be curbed. It may be added that it is also often true that boys, when an outlet for this trait along legitimate lines is lacking or not sufficient to stir them to action, often lose some of their enthusiasm to do things as the term progresses. Other explanations may be given covering other traits, but none of them may be valid and for that reason, no further attempt is made.

What conclusions, then, can be drawn from these experiments? Making full allowance for differences in conditions under which the teachers who conducted this experiment worked, differences in background, training, ideas, ideals and judgment, it may be reasonably concluded that while no norms of a valid nature have been established, yet the tendencies revealed are of such a nature that they indicate that such norms may be established, especially for those traits that are most easily influenced by the school and which supplement good training in the home.

Again, the experiments seem to show that improvements are possible along certain lines even though the experiments were conducted under most unpromising conditions. With a controlled group or groups small in number it is possible to secure marked results in the development of traits, attitudes and abilities. Moreover, with the establishment of norms, which are possible, the advancements may be actually measured in degree or percentages.

Finally, as a look into the future, the advancement of any given pupil each year may be compared with the norm so that at the end of four years a composite picture of the pupil's progress may be secured at a glance by simply superimposing each year's record over the norm. Then, when a college entrance board asks a principal for the record of a given pupil in dependability, initiative, honesty, good habits of work or in any other trait or capacity which a school determines to develop in its pupils, all it will be necessary to do will be to send the college the graph of the pupil in a composite picture for four years laid over the norm together with the key to the graph. That will tell the story at one glance.

TENDENCIES DISCLOSED BY CURRICULUM INVESTIGATIONS IN HIGHER EDUCATION AND THEIR IMPLICATIONS FOR SCIENCE TEACHING IN ELEMENTARY AND HIGH SCHOOLS

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Recently I had occasion to review curriculum investigations in higher education which had been published during the last four years. Outstanding concepts which were disclosed by an analysis of approximately 500 reports of various investigations may indicate trends which are in progress and, in turn, may have implications for teaching on lower educational levels. In democratic America, after a certain minimum of required time spent in school, each pupil proceeds along our single track school system as far as he cares, providing he has the requisite mental ability and financial backing. Under these conditions, it seems wise to supply a straight line of advance with no sharp turns nor backward recessions. College practice must inevitably have effects on elementary and high schools. For example, if junior college courses in science are to be of the survey or orientation character, which seems probable, high-school courses in science which are specialized in narrow subject fields will seem illogical. General integrated, survey, or orientation courses do not seem to develop naturally from specialized courses in physics, chemistry, or biology.

A decisive consensus which stood out in the curriculum investigations suggested the need for a broad general education for all students before specialization begins. Studies have brought home the great gaps which exist in the informational equipment of most people. Ignorance of simple scientific truths, for example, is widespread and appalling. A canvass of achievement test scores shows this to be true even for pupils who have been exposed to some courses in science. Surveys of courses taken by pupils show large proportions of our school population with little or no science in their programs. Similar facts are available with reference to other comprehensive fields of knowledge. In an enlightened and educated commonwealth consensus of opinion declares that this should not be allowed to continue. There is need for surveys of broad fields of knowledge by everyone so that each individual may understand what is going on in the world and have some appreciation of the problems which other people have. Obviously, student specialization which may occur too soon tends to prevent these needed broad surveys.

Among these 500 investigations, the most common reference was to new additions to the curriculum made imperative by changing life and changing knowledge. These new additions usually appear on the highest educational levels because it is there that research and discovery operate particularly. Later on this new knowledge filters down and is gradually incorporated in part at least into courses at the lower levels. For example, specialized knowledge of atomic structure discovered by research in chemistry filters down to general college science courses and finally to science courses in the junior high school or lower. It is possible, therefore, that boys and girls may know the possibilities in transmutation of elements although they may not understand the how and the why of it like the specialist does. Some of the new courses mentioned in different references were ones in theoretical and applied organic chemistry, aerodynamics, electronics, sanitary engineering, health, foods, applied psychology, psychiatry, relativity, social hygiene, marriage relations, educational measurements, time and motion in manufacturing, technology and civilization,

roentgenology, psychobiology, life insurance examinations, safety education, human morphology, theoretical and operative pharmacy, sound engineering, and so on. Sooner or later these effect lower school courses. And we agree that they should. Our science courses must be kept up to date. We must not teach science of a vintage of one or two decades ago.

Taking second rank among the investigations is the concept that curricula in higher education must be determined fundamentally by their purposes, objectives, and functions. This is a sane and sensible educational principle about which there will be no theoretical dispute. But the theoretical acceptance of the principle does not guarantee better practice. The job remains to scrutinize more searchingly aims and objectives, and consciously fashion patterns of practice to accomplish the adopted objectives. The reason why practice lags so far behind intelligent theory probably inheres in the inertia of formalism. No one will deny that systematic formalism has its advantages. It lays down principles of action to accomplish certain distant objectives. But it has its dangers in its tendency toward traditionalism and conventionalism. These often inhibit progress because aims and objectives are usually stated in terms which become outmoded with the passing of time. Organization of science into packages of physics, chemistry, zoology, botany, and so on was a natural outcome of efforts to facilitate further discovery of scientific truths. It still has its rightful place in specialization. But there may be question of this type of organization for boys and girls in our schools who are trying to acquire some conceptions of the rôle of scientific discovery and invention in refashioning our ways of life.

Standing out very prominently in the curriculum investigations is the emphasis upon individual development—growth of personality—as a controlling objective of all school planning. We note time after time statements of function in the imparting of ideals, attitudes, appreciations, and understandings as prominent phases of personality development; pleas for integrated, synthetic curricula to make an integrated personality possible and attainable. In these investigations, we notice innumerable declarations concerning the need for individual instruction, guidance, student freedom, a higher quality of achievement, comprehensive examination, curricula based upon social and individual needs, honors courses, tutorial instruction, service courses, integration of experience, unit courses, mental and physical development, student interest as a dynamic factor in achievement, correlation among courses, curricula of prevention as well as of cure, curricula planned to remove deficiencies, and so on. No one will contend that knowledge is not a prominent component of a well-ordered personality. On the contrary, it is a primary requisite. But in recent years there is a more and more urgent demand that knowledge be recognized only as a component of the well-ordered personality—that knowledge alone and of itself as a curriculum objective will not care for well-rounded personality development. It has become increasingly clear also that the methods we use in trying to impart knowledge may have bad rather than the good effects intended, on personality development. Therefore, the kinds of science which the school uses in elementary, junior high, or senior high school are very important and vital considerations. How shall science be taught in the elementary school? As a part of the curriculum in reading, or as a separate department of instruction, possibly adding to an already overcrowded curriculum? Perhaps a form of integrated curriculum where no field is overemphasized at the expense of the others may be the best form of organization. Then reading, writing, arithmetic, spelling, science, nature study, and all other necessary knowledge fields would have parts as components in a carefully planned program for individual and social growth

and development. These are problems which must be solved by further study, investigation, research, and experimentation. Among the 500 reported investigations, this need for more systematic research and experiment was reiterated again and again. The search for better methods and materials of instruction must be vigorously prosecuted.

There seems a very definite consensus in the demand in these 500 curriculum reports for a broad, distributed, comprehensive curriculum, preceding in a well-ordered sequence distinct specialization, for every student. Apparently the senior high school and junior college are being thought of as the divisions of the school organization where this broad general curriculum may be applied. There is a tendency becoming manifest in some quarters to combine these two institutions so as to prosecute this objective more expeditiously—notably at the University of Chicago. Survey, orientation, and comprehensive courses will have particular utility on this senior high-junior college level. Specialization, at least for all types of professional work, will follow after general education, and the term professional work is becoming more and more extended and inclusive. Even the barber of 1970 may be classed with the professional men. Certainly the optometrist, the orthopedist, the chiropodist, and perhaps the grocer, canner, and dairy man. Who knows the extent to which professionalization may be commonly practiced a hundred years from now? No one will deny that senior high schools and junior colleges may be fashioned to raise the educational level and meet the needs of all members of our population. From a purely a priori standpoint, those who have less intellectual capacity whom we now condemn to a menial, manual existence, need longer periods of time to reach satisfactory intellectual levels than do the more intellectually capable. If school should ever be thought of as a place where needs of all individuals may be met—not as a place where standards for the élite are to be maintained—we may expect to see, in a perhaps somewhat distant future a rather universal compulsory school attendance for all through the junior college level. This is a tendency which has been increasingly evident for several decades. The difficulties in finding employment constitute a significant factor in bringing it to pass.

A marked emphasis is given in the 500 curriculum reports to necessary correlation between theory and practice. This insistence is notable on all levels of higher education. Professional schools in engineering, medicine, dentistry, law, journalism, and business vociferously demand it. No efficient professional school wishes to turn out graduates to practice on the people without a somewhat extended period of interneship. Hospital interneships for prospective doctors are being paralleled in teaching, law, and engineering. The cooperative plan of school study and occupational practice has already made its appearance, notably at Antioch, Bennington, and Northwestern.

Added to this insistence of professional schools is the demand on the junior college and other levels. Why do students show such limited understanding? One reason at least is the absence of a continuous tie-up between practice and theory. We ask for more concrete treatment, for more illustrative material. Abstractions are convenient forms in which to put digested mental concepts, but with an insufficient apperceptive mass of experiences to give the abstraction a living and breathing body, the student has no real use of the abstraction. It doesn't mean anything to him. So there are many references to the importance of the application of knowledge; suggestions that the curriculum be made up of basic problems of everyday life; belief that curricula should be based on specific job analyses; emphasis upon field work; a curriculum of real experiences; a curriculum coextensive with life; the value of extra-curriculum activities, and so on.

All of these concepts project themselves down into the elementary, junior high, and senior high schools. If they are important in the junior and senior colleges and in graduate schools, how much more vital are they on lower levels where mental life is so much more immature. How necessary it is to relate theory to practice in our lower schools. In what ways may teachers better consummate this needed correlation in science teaching? Will it best be done in integrated courses where science is woven into everyday living with other intellectual experiences? Or will it best be done by introducing specialized courses in the various organized research fields of science—astronomy, geology, zoology, botany, chemistry, physics? When shall specialization begin? In the junior high school, senior high school, junior college, or senior college?

These are interesting and important questions and must be answered in terms of functions, purposes, objectives, and aims of education as a whole. Educational organization does then have an important place among educational problems. There is some use in thinking in terms of elementary school, junior high school, senior high school, junior college, senior college, graduate school, and professional school, from the standpoint of function. Thinking in terms of these divisions may serve to bring clarity out of confusion of thought with regard to the function of general or cultural versus specialized and vocational education. Does everyone need a general or cultural education? Where shall he get it? To what parts of our school system shall this task be delegated? Does everyone need depth in some specialized field? Why, and if so what parts of our school system shall operate in making it attainable? Does everyone need vocational education? What parts of our educational system shall be concerned with this specific function, if any? Educational organization was a prominent problem among the 500 curriculum reports, although in less degree than other phases to which reference has been made.

What is the rôle of organized science teaching in the attainment of these objectives and what form shall it take at each of the school levels named? What is its function as regards general or cultural education at each of these levels? Has it a function for future utility with reference to the suggested specialization of individuals and why should any individuals not expecting to work in scientific research be expected to specialize in any science? What is the function of science teaching for professionalized vocational work? To what extent does every citizen need science education? What individuals should be selected to specialize in scientific discovery or invention and how may they best be trained? What kinds of teachers do we need to instruct elementary, junior high, senior high, junior college, senior college, and graduate students in science?

I fear that this review has only precipitated questions. It was designed to touch the high points which stood out among the 500 curriculum reports which were analyzed. They contained data of a factual nature but solved few problems. For the most part they only raised problems and pointed the way toward needed research. One general suggestion emphasized the relationship of curriculum formulation to function. This is important in that it recommends a continuation of attempts to build curricula to definitely accomplish certain carefully planned outcomes. Several institutions of higher learning are engaged in a more thorough overhauling of curricula than they have ever known in trying to make their offerings more functional. Research literature fairly swarms with reports of innovations designed to put functional education into effect.

A second suggestion in the 500 reports placed distinct emphasis upon personality development as the primary curriculum function. Many of the innovations referred to the whole-hearted adoption of

this primary objective in the program of revision upon which they were embarking. This means that continuous study is going on to define personality and make its features identifiable so that curriculum efforts may be directed more intelligently. An added impetus has thus been given to the study of personality and character components.

A third suggestion stressed a closer relation between institutional education and life, in both its general and professional aspects. This emphasizes again a functional education—the continuous tie-up between theory and practice. Of what use is education if it doesn't function in the life of the individual? There is a distinct movement among the better institutions of higher learning to facilitate this needed correlation.

A fourth suggestion directed attention to the importance of organization and departmentalization in higher educational institutions. The association of organization with better planning to accomplish a functioning education is a further indication of the stress being given to the development of purposeful education.

For the student of education there is nothing startingly new in the investigations reported. We have talked about functional education for a long time. But the fact that there are so many institutions definitely embarking on complete revisions of their programs in keeping with this concept makes one feel that now something is happening. Some one is beginning to do something about it. And subsidiary researches are beginning to point more and more to concentration on this matter of personality development, what it means, and how it may be accomplished in actual behavior.

There are conservatives still watchfully waiting and labelling attempts at reconstruction fads and fancies which will vanish with the morning fog. And, too, there are the ultra-liberals who would throw overboard all remnants of past tradition. And there may be super-salesmen in some higher educational institutions who are merely putting on sales campaigns to sell their instructions to prospective students. However, there are signs of advance among all the suggestions given and among the innovations already started.

Science education is but one phase of the total educational process and must bring to fruition the same general objectives. The impulse toward functional education does not have any more promising material with which to work than that offered by science. This is an age which utilizes scientific discovery and invention as has no previous age. The environment is one of scientific achievement, and functional education will bump into this fact at every turn. Research and experiment in education are attempting to apply scientific method for the solution of educational problems. In view of past achievements in the utilization of scientific method we have great hopes of improved educational institutions and processes. If we haven't yet solved the problems of science education on the lower levels, we may feel that we are perfecting devices which will eventually help in their solution. And in a final analysis we must realize that there will always be problems with us.

WHAT ARE THE BIOLOGY INTERESTS OF SOPHOMORE HIGH SCHOOL GIRLS?

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Problem and Procedure

What interest in biology do sophomore girls possess when they enter upon a year of general biology in a city high school? What topics and activities which have biology as their keynote do the girls find of most interest? Are plants more interesting to them than animals, diseases of man more interesting than diseases of other animals, quiet activities more interesting than active ones? These and other questions were answered by one hundred twenty-seven girls in the sophomore class of a city high school with a total pupil population of fifteen hundred. These girls constituted 18 per cent of all girls in the school, 42 per cent of all girls in the sophomore class, and 70 per cent of all girls taking general biology.

The girls came from three types of environment; 41 from a factory section of the city, 72 from what might be called a middle-class residential section, and 14 from a definitely rural section. Over half of the girls had one or both parents born outside of the United States. The range of ages was from 13 to 18, with the greatest number at 15. The I.Q. range was from 78 to 155. There were 32 girls having I.Q.'s between 120 and 155; 56 between 100 and 119; and 39 between 78 and 99. Most of the girls had pursued general science in the junior high school and all but three had taken the course with the same teacher. Seventy-four had received a final mark of 85 or above in this course. The girls were quite equally distributed in the college, general, and commercial curricula. The vocational objectives were varied; 43 were aiming toward the arts and professions, other than scientific; 49 toward some scientific vocation; 22 toward commercial vocations; and the others toward such positions as hairdresser, mortician, and dressmaker. Their camping experience was fairly extensive: 56 had had at least a week in a Girl Scout, private, or family camp, and most of the others had had some briefer experience in camp life. Their country experience, too, was richer than might be expected; 31 had lived more than two months in the country; 14 had lived all or most of their lives in the country, and practically all of the others had had at least a week in the country. Almost two-thirds of the group had at some time taken care of a garden. All but three had had at least one pet. Many of the girls had had five or six different sorts of pets, such as alligators, canaries, cats, dogs, skunks, and guinea-pigs. Only ten had never made a collection of any kind. Many had made collections of several types, such as flowers, shells, match boxes, and pictures. These facts on the background and experiences of the girls used in the study will help to give a basis for the discussion of their biology interests which follows.

The list of fifty biology activities which was distributed for marking by the girls was composed of as many different types of interests as could be found. Items were included which had a music or a literary or an art angle so that girls who had special aptitudes for these things could be reached. Items were included which would be representative of the various life experiences which the girls might be expected to have had, as well as items on subjects which they might have read about. The mimeographed sheets which were used also included a list of thirty-four subjects of a biological nature. Both of these lists were to be marked by the girls as to the amount of interest which they felt in each. Five columns were made to the right of the ac-

tivities and topics listed. These were headed as follows: "Not at all," "Slightly," "Somewhat," "Much," "Very much." The first day of the school year was given over to the filling out of these sheets, and to the obtaining of information on the girl's family background, school experience, and out-of-school activities. The teacher was unknown to most of the girls and it was made clear that the sheets had nothing to do with the course in biology for which they were registered.

For purposes of the study, numerical values of 0, 1, 2, 3, and 4 were assigned to the five headings. Summary Averages of Intensity of Interest in each item were obtained by dividing the total degrees of Interest as indicated by the girls, by 127. Also, these averages of all markings of each item, as well as the averages of Plant and Animal Interests, were changed to percentages for purposes of easier comparison. This presupposes that a marking of the column "Very much" indicated 100 per cent interest in that particular item, and of the column "Not at all" indicated zero per cent interest. Though this is not a possible condition, it serves as a useful device.

FINDINGS OF THE STUDY

The summary tables which follow give the ranking, the actual total Average of Interest, and the total Average of Interest expressed as a percentage, for each of the 84 activities and topics, as marked for degree of interest felt in each by the 127 girls used in the study.

DISCUSSION OF THE SUMMARY TABLES

What generalizations can be made from a study of the rankings of the items on these two tables? Let us examine first the fifty items of Table I. Do active types of biology activities occasion more or less interest than the less active ones? In the first twelve items, nine are of an active type; while of the last twelve items, only six are active. Are outdoor activities of more interest than indoor ones? Of the first twelve items, eight are distinctly outdoor; while of the last twelve items, only four are outdoor. Do activities with which the girls have had actual experience occasion more interest than those about which they have only read? Of the first twelve items, only the item "Go out in glass-bottomed boat to observe undersea life" is unknown to all. Of the last twelve items, only six have been experienced by even a few of the group. Are activities in which animals are included of more interest than those in which plants are included? Of the first twelve items, only one activity is with plants only, only three with animals only. The others are of a general nature. There would seem to be little difference, then, in the amount of interest, as shown by ranking of activities, between animal and plant items on this table.

Is there a wide range of interests in this table? The camping item which ranks first on the list has an Average of Intensity of Interest of 3.236 for the 127 girls. The item ranking fiftieth, "raise animals for sale," has an Average of 0.669. There is then a difference of 2.567 between the two items; or in other words, the first ranking. item is almost five times as large as the fiftieth item.

This wide range in the first table is not paralleled in the second table if only the first and last items on each table are compared. If, however, the last item of the Table of 34 Biology Topics is compared with the item ranking 34th on the Table of 50 Biology Activities, it will be seen that a range of 1.11 to 3.039 must be compared with one of 1.756 to 3.236. There is a difference of 1.929 on the Topics Table as compared with a difference of 1.480 on the Activities. Evidently, Activities are both of greater interest and of more even interest, since the range is smaller and the Averages higher, than those on the Topics table.

What generalizations can be made by an examination of the interests in biology topics shown in Table II? It will be noticed immediately that snakes and spiders

end the list. One wonders whether a group of boys would have ranked these last. Are familiar objects of greater interest in this table as they were in the first table? Of the first nine items, all are familiar; of the last nine, excepting the last two, all are of the type that most people know little about. Are plant topics of more interest than ani-

TABLE I

INTENSITY OF INTEREST IN FIFTY ACTIVITIES

Rank	*Activity*	*Average of Intensity*	*Per cent of Average Intensity*
1	go camping	3.236	80.9
2	go to Museums and Aquariums	3.087	77.18
3	take care of pets	2.953	73.83
4	go out in a glass-bottomed boat to observe undersea life	2.850	71.25
5	make collections of wild flowers	2.779	69.48
6	notice plants and animals while walking or riding	2.757	68.93
7.5	raise animals for fun	2.717	67.93
7.5	look at famous nature paintings	2.717	67.93
9	go on nature walks with friends	2.583	64.58
10	go hunting with a camera	2.567	64.18
11	look at pictures of plants and animals	2.559	63.98
12	go fishing	2.520	63.00
13	go hunting	2.394	59.85
14	go on nature walks with a leader	2.299	57.48
15	raise plants for fun	2.252	57.3
16.5	look for birds' nests	2.228	55.7
16.5	make collections of leaves	2.228	55.7
18	make collections of shells	2.189	54.83
19	take photographs of plants and animals	2.173	54.33
20	identify animals found	2.047	53.18
21	go to movies about plants and animals	2.126	53.15
22	identify plants found	2.094	52.35
23	earn Girl Scout nature badges	2.039	50.98
24	perform experiments with plants	1.984	49.6
25	make collections of photographs of plants and animals	1.976	49.4
26	try to recognize birds by their songs	1.960	49.0
27	travel about the country to collect plants	1.921	48.03
28	talk to people who know much about nature	1.913	47.83
29.5	make leaf-prints, plaster molds, and models of plants and animals	1.906	47.65
29.5	explore regions for new plants and animals	1.906	47.65
31	travel about the country to collect animals	1.795	44.88
32	collect newspaper clippings about plants and animals	1.787	44.68
33	draw or paint nature objects or scenes	1.764	44.10
34	listen to music which portrays nature	1.756	43.9
35	perform experiments with animals	1.717	42.93
36	make collections of mosses, ferns	1.669	40.73
37	go on nature walks alone	1.614	40.35
38	read nature stories	1.543	38.58
39	keep an accurate record of nature objects found	1.519	37.98
40	read books giving nature facts	1.402	35.05
41	breed animals other than fish	1.362	34.05
42	draw things seen under a microscope	1.354	33.85
43	read nature poems	1.339	33.48
44	make collections of animal footprints	1.315	32.88
45	illustrate a nature diary with sketches	1.299	32.48
46	breed guppies and other fish	1.094	27.35
47	raise plants for sale	0.953	23.83
48	listen to lectures about nature	0.937	23.43
49	make collections of seaweeds	0.803	20.08
50	raise animals for sale	0.669	16.73

mal topics? The first answer to this question would be affirmative, as it would have been by early educators in the United States who believed that botany was a more gentle subject for girls. But what do we find in this group of modern girls? Of the first nine items, six are animal topics; of the last nine, again excepting the snakes and spiders, three are animal topics. Thus it seems that, for this group of girls, fear or repugnance figures largely in the interest ratings, that familiar topics are of most interest, and that animal topics exceed plant topics in interest.

TABLE II
Rank in Interest for Thirty-four Topics in Biology

Rank	*Topic*	*Average*	*Per cent Average*
1	animals as pets	3.039	75.98
2	wild flowers	2.898	72.45
3	garden flowers	2.819	70.48
4	birds as pets	2.559	63.98
5	animals in a zoo	2.433	61.85
6	birds out-of-doors	2.425	60.63
7	trees	2.409	60.23
8	human diseases	2.394	59.85
9	fish in an aquarium	2.236	55.9
10	garden plants	2.205	55.13
11	prehistoric animals	2.179	54.48
12	fish out-of-doors	2.173	54.33
13	prehistoric man	2.07	51.75
14	prehistoric plants	2.063	51.58
15	seashore life	2.039	50.98
16	wild animals	2.024	50.6
17	ferns	1.85	46.25
18	fresh-water plants	1.843	46.08
19	animal diseases, other than human	1.835	45.88
20	fresh-water animals	1.819	45.48
21	seaweeds	1.779	44.48
22	grasses	1.732	43.3
23.5	mosses	1.638	40.95
23.5	plant diseases	1.638	40.95
25	frogs, toads, salamanders	1.573	39.33
26	bacteria	1.535	38.38
27	insect pests	1.519	37.98
28	insects	1.512	37.8
29	lichens	1.386	34.65
30	mushrooms	1.315	32.88
31	molds	1.307	32.68
32	evergreens	1.283	32.08
33	snakes	1.259	31.48
34	spiders	1.11	27.75

Let us consider in more detail the question of plant *versus* animal interest. For the past twenty-five years, educators have sought the answer to this question. Many studies have been made, using children from kindergarten to high school. In general, it was found that animals were of greater interest than plants, and that boys were more interested in animals than were girls. What do we find in this present study? A comparison of the 28 plant items with the 30 animal items found in the total list of 84 biology activities and topics is shown in Table III.

TABLE III
Relative Interests in Plants and Animals

Items	*Average*	*Average in %*	*Range of Averages*
30 Animal Items	1.987	49.68	0.067 to 3.267
28 Plant Items	1.812	45.27	0.036 to 3.65
84 General, Plant and Animal Items	1.945	48.63	0.048 to 3.393

Thus, once more, animal items are appreciably of more interest than plant items, a difference of 4.41 per cent. It will be remembered that in a comparison of the first twelve and the last twelve items on the biology activities summary table, there was little apparent difference in interest between plant and animal items. In the biology topics (Table II), animal topics were more frequent in the first nine items than in the last nine. In general, then, we can say that the girls in this study show slightly more interest in animals than in plants, at least as shown by their ratings on the total list of eighty-four items.

Classroom Notes

Unity in the metric system.—Much is made of the perfection of the metric system as a scientifically devised basis for weights and measures because of the use of decimal relations and the inter-relation of various units. As is commonly pointed out in science texts the unit of length, the meter, was originally intended to be one ten millionth part of the earth's quadrature. The unit of mass in turn was decided upon as the mass of one liter of water at 4° centigrade. Although the meter is now defined in terms of the Standard Meter in the Bureau of Archives at Paris and the kilogram in terms of the Standard Kilogram; the length, volume, mass relationship still holds even though there are 10,000,856 meters in the earth's quadrature.

In any system of measurement the units of length, mass and time are considered as fundamental and other units are derived from them. For instance: volume is length cubed, velocity is length divided by time, and acceleration is length divided by time squared. In this way complicated units of measurement may be reduced to the three fundamentals of which in turn two, length and mass, bear a unit relationship and we commonly define a gram as the mass of one cubic centimeter of pure water at 4° centigrade.

Could we have a system of measurement in which there was only one fundamental unit? Suppose that this were a standard meter bar from which in turn all units of measurement might be derived. Would not such a system be ideal?

This could be done if the units of length and time were related. The unit of time is now taken as the second which is $\frac{1}{86,400}$ of a mean solar day. As our time system is based on the motions of the earth it would be foolish to think of changing such a universal system. But, through the simple pendulum, a definite relationship between length and time already exists. Such a pendulum set up where the acceleration of gravity is 980 $cm.^2$ (about latitude 39°) would make a single vibration in 1.0035 sec. This is found by experiment and by the simple formula $T = \pi \frac{L}{g}$ where T is the time in seconds, L is the length of the pendulum in centimeters, and g is 980. Suppose that we wished a pendulum that vibrates exactly in the period of one second. If we could increase g to 986.96 $cm.^2$, our unity would be obtained and a meter pendulum would tick off seconds. This unfortunately is impossible as there is no place on the earth where "g" has such a value.

On the other hand, suppose the standard meter were changed by shortening it to 99.29 per cent of its present length. It would then tick seconds as a simple pendulum at a spot where g equalled exactly 980. Hence, by a decrease of .71 per cent in the standard meter, a unit might be obtained which would bear unit relationship to mass and time and from these in turn our derived units might be obtained.

It is no doubt highly impractical to consider changing the metric unit now. It is unfortunate that, in as much as the standard meter was a little short of the desired fraction of the quadrature, it was not still a little shorter and thus give us a single metric unit. Perhaps the most interesting phase of the whole question is how this came to being realized by pure chance. Students invariably are interested in the possibility of the unit system of measurement. Why the average textbook in physics fails to emphasize the relation of the seconds pendulum to the metric unit of length is an interesting question. In fact, in elementary work the relationship is so close that experimentally it is difficult to detect the error and approximately, at least, the metric system is a unit system where mass and time may be derived from length.

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Certain substitutes for Paramoecium caudatum in high-school and college biology.—It is safe to say that in almost all biology courses Paramoecium has been and is being used as a typical one-celled animal. Together with Amoeba, it serves to introduce the student to the Protozoa and to living things. Paramoecium is used chiefly because of the ease with which it is cultured. Yet, certain factors make it unsuitable as an object of study for the young high-school microscopist.

The elementary student of biology approaches the study of microscopic living things with some eagerness and anticipation. Almost at his first lesson he is met by a fast moving elusive animal which may not be held in focus by his inexperienced manipulation. If lens paper or a jelly is successful in stopping the Paramoecium, the student finds that the animal takes on various forms and contortions. The animal under such conditions is not normal but certain structures can be seen with certainty by the student. These are the contractile vacuoles, food vacuoles (especially if the animal is treated with carmine) a pellicle, and cilia; the latter are seen only under favorable conditions of lighting and focus. The oral groove may be seen but the student obtains little knowledge of its oblique position and of the adoral zone of large cilia. To see the nucleus, the animal must be fixed and stained. Sometimes, it is desirable to note the "avoiding reaction" of Paramoecium. On a slide, this is very difficult. The protozoan moves backwards with the same facility as it moves forwards. With lens papers as a trap, this avoiding reaction may not be seen.

While other protozoa could not be obtained successfully in culture the Paramoecium was an acceptable animal. Since, then, certain methods

have been published[1,2] which have made other animals available. Some of these animals are Stentor coeruleus, Spirostomum ambiguum and Blepharisma lateritia. Stentor (Fig. 1) is a blue

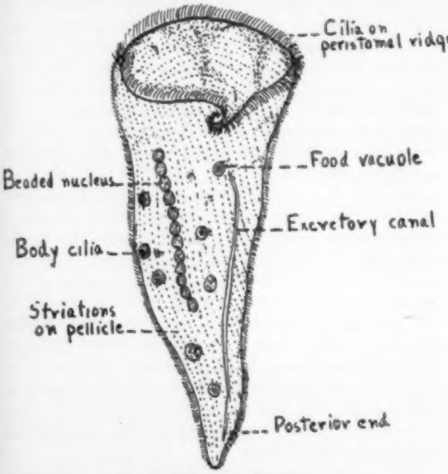

FIGURE 1.—Stentor.

trumpet-shaped animal, about 1000–2000 μ or about five times the size of Paramoecium. When it is mounted on a slide whose cover slip is propped up by a bristle, the animal, if undisturbed, will attach itself to debris or to the bristle and remain stationary. It can, and should be, prepared one-half hour before it is used in class. Again, if the solution A (see later) is added to the slide, the preparation may be used the entire day.

When it is viewed through the microscope the extended Stentor has a trumpet-like shape. The powerful adoral cilia are clearly seen as they beat food down the large gullet. The nucleus is easily observed in the living condition as a long bead-like structure. The cytoplasmic inclusions are evident, but the contractile vacuole is discerned only with difficulty by the average high-school student. The animal responds readily to foreign stimuli, or to jarring of the slide, by contracting.

Spirostomum (Fig. 2) is another large animal about 1000–2000 μ in length. It swims slowly and its large worm-like shape is easily followed. The cilia, oral groove, and the contractile vacuole with its long excretory canal can be clearly seen by the poorest of high-school microscopists. It responds quickly to any jarring or to the presence of an obstacle by a contraction into a shorty stubby spiral. As the preparation is permitted to dry out the long bead-like nucleus comes into clear view.

Blepharisma (Fig. 3) is a pink or red animal, about the size of Paramoecium. Its very slow movement enables the student to follow it with ease. Cilia, oral groove, a posterior contractile vacuole, and cytoplasmic inclusions are seen very easily. Its nucleus, however, may not be seen in the living condition. Furthermore, a single preparation almost always has dividing individuals.

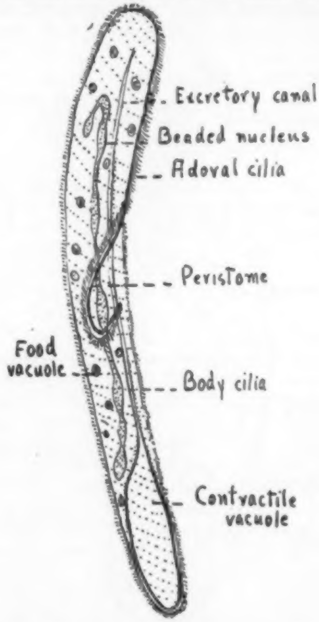

FIGURE 2.—Spirostomum.

A very obvious advantage in Blepharisma and Stentor is their color. The student will not mistake them for any contaminants. On the other hand, in a Paramoecium preparation, the student, due to his inexperience with size and form, will often focus his attention on Colpidium or some Hypotrichs, or any gray or colorless animal.

The culture of these animals is profitable in so far as quantity and quality of animals is concerned. The method has been described as the technique used for Arcella in the papers previously cited. However, it is well to give here a brief résumé of these references. The following animals, including Stentor, Blepharisma, and Spirostomum, have been cultured very successfully by the method to be described, or a minor modification of it: Amoeba dubia, Amoeba proteus, Paramoecium bursaria, Vorticella sp., Arcella vulgaris, Actinosphaerum eichornii, Stylonichia notophora, Cypris, Cyclops, Aelosoma, Dero, Nais and Pectinatella.[3] From observations it appears that the method is suitable for many invertebrates due to the fact that the medium appears to be a good substitute for pond water.

[1] Brandwein, Paul F. *American Naturalist, 69*: 628, 1935.

[2] Brandwein, Paul, and Cohen, A. J. *American Naturalist, 70*: 429, 1936.

[3] Amoeba is cultured without agar. Best cultures are obtained at 20° C. Vorticella is cultured in Solution A with a small amount of hard egg yolk suspension supplied as food.

The method is as follows: A cleaned finger bowl is dried and a 1.5% warm solution of agar in distilled water is poured into it so that a one-eighth inch (or thinner) layer is formed. In this five grains of ordinary store rice are imbedded. The grains should be roughly equidistant from one another, *i.e.*, one in the center and the other four

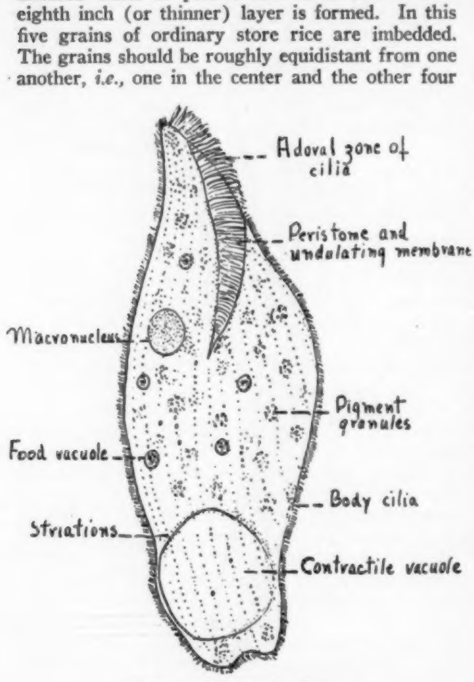

FIGURE 3.—Blepharisma.

about it near the periphery of the agar. This is permitted to cool. At this time, 30 cc. of the following solution (Solution A) are added.

NaCl	1.20 gms.
KCl	0.03 "
$CaCl_2$	0.04 "
$NaHCO_3$	0.02 "
Sörenson's phosphate buffer solution (pH 6.9–7.10)	to 50 cc.
Distilled water	to 1000 cc.

This is a stock solution. It must be diluted 1 part to 10 parts of water before use.

The finger bowl is permitted to stand overnight. In the morning, it is inoculated with the organisms together with 10 cc. of the fluid in which they are found. Growth is rapid. If the room is at about 20–40° centigrade, the finger bowl culture contains sufficient material for 80–100 students in two or three weeks. Sub-culturing depends on the individual. The culture may be kept in good condition at 20–24° Centigrade for six weeks to two months.

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The construction and operation of a water barometer.—In all teaching, concepts are built up through pupil experiences. It is doubtful whether any concept is ever fully realized. Every new experience that an individual might have would add or modify the pre-existing concept. In developing a concept, the teacher should set up, or cause to be set up, as many and as varied situations as are necessary to give the pupils the experiences needed to develop proper understandings. This is the rôle of the teacher. The teacher can direct the pupil's activities and experiences and thus assist in his education.

In order that a pupil may develop a full understanding of air pressure many and varied experiences are necessary. In addition to the usual laboratory demonstrations, teachers will find the water barometer valuable in giving the pupils experiences which are not usually enjoyed, but which will greatly assist in their understanding of the operation of lift-pumps and siphon water systems, which are sometimes found on hillside farms. The pupil will also realize that in as much as water is lighter than mercury, the water column will have to be higher than the mercury column in order to balance the air column.

Any science teacher can build, or if fortunate enough to have a school plumber, can have a water barometer built at very little cost.

The barometer in the accompanying diagram was designed to make filling easy. In effect it is a long

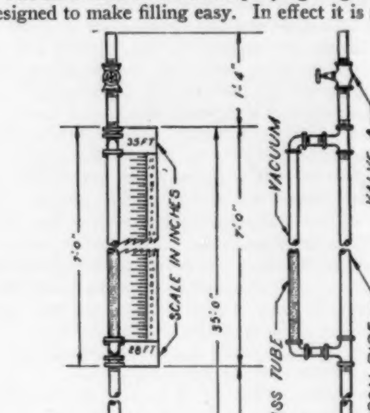

FIGURE 1.—Water Barometer

galvanized iron pipe with a water gauge. The gauge shown here is seven feet long. It need not be so long. There are two water valves, one above the gauge and one near the bottom of the pipe. The barometer is permanently attached to the building, with the upper end outside and just beside of one of the laboratory windows.

In filling the barometer, water is run in at the top with both valves open until the vessel (a glass jar or tin can will do) at the bottom is filled, when the lower valve is closed. (The lower valve must be below the water level of the container so as not to pocket air.) The pipe is then filled to the top. The top valve is now closed and the lower valve again opened. The water column will sink to where it is balanced by the existing air pressure. The small pipe above the upper valve is filled with water to seal the valve.

The above experiment may be modified by attaching a hose and air pump to the upper end of the pipe and exhausting the air. The pupils will see that the water will rise to the former level but no farther and they will come to realize that the water is raised and supported by air pressure and not "sucked up" by the pump.

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Other useful plants for biology teachers.—In a previous note,[1] there were set forth the advantages of an exotic of the *Balsaminaceae, Impatiens Holstii,* Engler and Warb., as a laboratory plant. It is now desired to list other species, many of them old favorites in the biological laboratory, which have been demonstrated to be of fairly wide utility.

While a greenhouse is practically indispensable so far as the modern conception of a biological laboratory is concerned, room may usually be found in the laboratory itself for some plants of this type and they usually survive if conditions of heating and lighting are what they should be in a laboratory. Others may add to the list so that eventually there may be on hand information concerning the plants with which a departmental greenhouse can be advantageously stocked. Additionally, while the emphasis of this note is upon the physiological and morphological uses to which these plants may be put, they also offer some advantages for instruction in systematic botany in so far as they represent typical family characters. Hence the family name is added, and references made to the source of description.

The following exotic species are listed in Bailey's *Manual of Cultivated Plants.* They do best with a fairly rich pot soil, moderate watering and heat. They may be obtained from commercial greenhouses, dealers, or public conservatories.

Nephrolepis exaltata var. *bostoniensis* Davenport. Boston Fern. Polypodiaceae. A source of fern habit material; prothallia may be found developing around the plant. This species appears to be in an active state of mutation, at least eight sub-varieties having been described of drooping, spreading, variously modified kinds; hence the plant furnishes excellent demonstration material for the study of variation. Decidedly ornamental.

Pandanus Veitchii Dall(?). Screw Pine. *Pandanaceae.* Leaves two or three broad; two or three feet long, stiff, spiny margined, excellent for the study of stomata and other epidermal structures. Stilt like roots are produced above the ground. Good for the study of monocotyl vegetative characters. Ornamental.

Ficus elastica Roxb. Rubber Plant. *Moraceae.* This old acquaintance can be used for demonstrating epidermal cells, cystoliths, aerial roots, ochreae (sheaths of stipules), and in propagation experiments. Ornamental.

Bryophyllum pinnatum Kurz. Air Plant. *Crassulaceae.* Useful in illustrating natural propagation by means of leaves which grow from the crenations of the leaf after removal from the plant —hence its name. Succulent, hollow stemmed; the subject of interesting scientific experiments and of some folk-lore interest.

Mimosa pudica L. Sensitive Plant. *Leguminosae.* The leaves may be set in motion by the action of light, stimulus of shock, and by gravitational stimuli; hence the plant is useful in demonstrating thigmotropism. It also shows autonomic and sleep movements, as well as rigor. Well developed pulvini. An excellent experimental plant for students and one which arouses considerable curiosity in the laboratory. The preceding may suggest further studies of our native sensitive pea, *Cassia Chamaecrista* L.

Pelargonium hortorum Bailey. Fish Geranium. *Geraniaceae.* Excellent for demonstrations of glandular hairs, crytals in peripheral cells, phellogen and intrafascicular cambium. Nectar spur. Succulent stem; a favorite in experiments showing the circulation of sap and the manufacture of starch. Easily propagated by cuttings. Ornamental.

Begonia semperflorens Link and Otto. *Begoniaceae.* Other species of *Begonia* also present possibilities for the laboratory. Cuttings will form adventitious roots in water or moist soil, as will also leaves. The succulent stems in addition to leaf bundles possess cauline bundles which are situated in the pith. Excessive watering or dryness will cause these plants to lose their leaves. Ornamental.

Primula obconica Hance. (Chinese) Primrose. *Primulaceae.* Winter blooming, several shades of color and varieties with frigid, crisped or double flowers. Longitudinal sections through the marginal teeth of the leaves show the structure of hydathodes which excrete water during guttation. The glandular hairs on the petioles are irritating and poisonous to some people. Useful in experiments demonstrating the manufacture of starch in the leaf. Ornamental.

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Myerstown, Pa.

[1] Grier, N. M. "A Useful Plant for Biology Teachers." SCIENCE EDUCATION: 15: 447–448; January, 1930.

Editorials and Educational News

MINUTES OF THE EIGHTEENTH ANNUAL MEETING OF THE NATIONAL COUNCIL ON ELEMENTARY SCIENCE

The eighteenth annual meeting of the National Council on Elementary Science was held in New Orleans February 20, 1937. The report of the meeting submitted by the secretary follows:

Helen Dolman Blough, the president, presided at both the morning and afternoon sessions. The announced program of papers and reports was carried out with the exception that Miss Myrtice Pledger, of the East Texas State Teachers College, was unable to appear and present her paper.

The treasurer's report for the year indicated:

Receipts from all sources	$146.32
Total expenditures	114.77
Balance on hand on February 17, 1937	31.55

The report of the business manager of *NCES News Notes* showed that the magazine had been practically self-supporting during the year. The twenty dollars appropriated from the general funds of the Council to *News Notes* had been used to increase the size of one issue from 16 to 24 pages.

A discussion of the advisability of allocating a certain fixed portion of the membership dues to *News Notes* in order that the magazine might be improved was opened by Mr. Whitman. It was moved by Mr. Wildman and seconded by Mr. Carpenter that fifty cents of every dollar of membership dues be allocated to *News Notes* on a one-year trial basis. The motion was carried.

The possibility of working out a plan of effective cooperation between *NCES News Notes* and *Science Education* was suggested by Mr. Pieper. It was moved by Mr. Webb and seconded by Mr. Wildman that the executive committee of the Council confer with Mr. Pieper during the year concerning the possibilities of cooperation and present a report at the next annual meeting.

Mr. Wildman, as chairman of the Publicity Committee, presented a program of seasonal activities carried out in Philadelphia. He asked for the cooperation of members of the council in working out similar programs in other localities.

The following report of the nominating committee was made by Mr. Robertson, one of the members of the committee:

President, C. L. Thiele, Detroit Public Schools, Detroit, Michigan.

Vice-president, Harry A. Cunningham, Kent State University, Kent, Ohio.

Secretary-treasurer, Mildred Fahy, Pierce School Chicago, Illinois.

It was moved by Mr. Webb and seconded by Mr. Curtis that the secretary be instructed to cast a unanimous ballot for the officers recommended by the nominating committee. The motion was carried.

The question of whether the National Council should continue to meet each year in the city chosen as a meeting place by the Department of Superintendence was raised. The motion was made by Mr. Caldwell and seconded by Mr. Robertson that the executive committee of the Council confer with the executive committee of the National Association for Research in Science Teaching concerning the meeting place for next year. The motion was amended by Mr. Pieper to the effect that the membership of the National Council be polled concerning the meeting place before any decision involving a change from the established practice be reached. The motion, as amended, was carried. The meeting adjourned.

Harry A. Cunningham,
Secretary-Treasurer

CONFERENCE ON EDUCATIONAL BROADCASTING

A release from the Executive Secretary of the Second National Conference on Educational Broadcasting, which will be held at the Drake Hotel in Chicago, November 29, 30, and December 1, 1937, indicates the objectives, sponsors, and plans of the conference. We quote certain sections of the release:

The objectives of this conference, as formulated by a committee, are as follows:

I. To provide a national forum where interests concerned with education by radio can come together to exchange ideas and experiences.

II. To examine and appraise the situation in American broadcasting as a background for the consideration of its present and future public service.

III. To examine and appraise the listeners' interest in programs that come under the general classification of public service broadcasting.

IV. To examine the present and potential resources of education through radio.

V. To examine and appraise the interest of organized education in broadcasting.

VI. To bring to a large and influential audience the findings that may become available from studies and researches in the general field of educational broadcasting, particularly such studies and researches as may be conducted by the Federal Radio Education Committee.

In addition to the eighteen organizations which sponsored the first Conference, the following have been selected to sponsor the second, to increase the scope of the social and cultural interests which will be represented on a nation-wide basis: American Association for the Advancement of Science, American Association of University Women, American Federation of Arts, American Library Association, American Public Health Association, Music Educators' National Conference, National Council of Parent Education, National Federation of Music Clubs, and the National University Extension Association.

The American system of broadcasting, an evaluation of broadcasting from the point of view of the listener, educational broadcasting, and the future of radio have been selected as the topics of the four general sessions. Speeches on these subjects will be made by prominent representatives of education, the radio industry, and the listener, and will be followed by periods of open discussion.

Each afternoon will be devoted to section meetings in which specialists in the various fields covered in the general sessions will discuss specific aspects of each of these topics. At the banquet on the second evening, the speakers will discuss the international significance of radio.

RATINGS OF INSTRUCTIONAL MATERIALS

While it is too early to judge the value of the plan for rating instructional materials inaugurated by *Education Digest,* our readers will be interested to follow the evaluations of textbooks and courses of study presented in recent and forthcoming issues of the journal. The release concerning the plan includes the following statements:

Because the superabundance of instructional materials makes it difficult for educators to choose materials best suited to their needs, the editors of the *Education Digest* are seeking to help solve this problem by providing ratings on a five-point scale for various instructional items. The ratings are made by experts selected on a nation-wide basis.

The textbooks, etc., are rated on content, workmanship, interest, teachability, and attractiveness. All fields of education from pre-school through teacher-training are represented in the items rated. Several psychological tests were rated for efficiency in the September issue.

U. S. GOVERNMENT PUBLICATIONS

In a letter of the Public Printer of the U. S. Government Printing Office to the Chairman of the Joint Committee on Printing of the House of Representatives, which is quoted in the *Congressional Record* (7218–147), one finds some interesting information on the extent of printing and circulation of government publications. The Public Printer states that the general public should know that the Government Printing Office operates a book store where 65,500 different publications may be procured at most reasonable cost. During the fiscal year of 1937 the office sold 10,351,203 publications. Many of these publications are of interest to science teachers. The best sellers, by title, with number of copies of each sold to date are:

Classroom Growth Record	2,130,162
Infant Care	1,735,066
Prenatal Care	819,847
The Child from 1 to 6, His Care and Training	763,328
Keeping Fit	572,119
Healthy, Happy Womanhood	554,628
Child Management	480,875
Health Education Series 2, Diet for the School Child	443,534
The Wonderful Story of Life—A Mother Talks with Her Daughter	367,599
Manual of First Aid Instruction	364,143
What Builds Babies	273,350
House Insulation, Its Economies and Application	211,800
Out of Babyhood into Childhood	207,308
The Wonderful Story of Life—A Father Talks with His Son	198,479
Furniture—Its Selection and Use	175,127
Grade Marking of Lumber for Consumers' Protection	132,931
Cardinal Principles of Secondary Education	129,820
Story of the Declaration of Independence	119,931
Clothes Moths and Their Control	118,190
Chemical Composition of American Food Materials	111,205
How to Judge a House, Wood Utilization Committee	104,309
Fifty Common Birds of Field and Orchard	89,861
Insulation on the Farm	54,119
Home Canning of Fruits, Vegetables, and Meats	49,143

DISCUSSION GROUPS IN SECONDARY EDUCATION

The Department of Secondary School Principals of the National Education Association through its executive secretary, Mr. H. V. Church, is developing materials for use in discussion groups which are being organized throughout the country to study trends and problems in secondary education. A tentative series of approximately 150 questions have been prepared, bearing upon Part II of the report of the Committee on Orientation of the *Issues and Functions of Secondary Education.* Part II refers to Functions of Secondary Education.

Science Teachers will be much interested in the report of the committee and in the discussion problems, particularly in view of the fact that science has been given such a prominent place in the report.

It is assumed that copies of the questions for discussion may be obtained from the executive secretary, 5834 Kenbark Avenue, Chicago. A few of the questions are listed below as illustrations.

What next steps toward a better program of integrating education in secondary schools are possible?

Are the common machines becoming so complex that the consumer must depend upon the service provided by the manufacturer and hence need know very little about them?

By what means can the school most effectively keep the social values involved in higher individual activities constantly in the consciousness of all learners? Specifically how can this be done in each of the special fields of learning, school training, and experience now usually found in the high school?

Facing frankly the financial limitations that confront most schools, what can you and your faculty do to make your records more useful for the exploration and guidance of pupils?

How may experimental procedures be designed to clarify method and establish an organization so that basic laws and principles may be best understood and applied?

What are the effects when pupils are required or permitted to take subjects the values, immediate or remote, of which they do not appreciate or believe in, subjects which they neither master nor retain, and which they find no or few opportunities to apply? How do you explain and justify the prescription of subjects which seem to youth of so little value that they are dropped at the earliest possible moment and are seldom if ever revived for later use of any kind?

CALIFORNIA COOPERATES IN CONTINUOUS SCIENCE PROGRAM

A report of the California Committee of the Department of Science Instruction of the National Education Association, dated January 19, 1937, contains the following resolutions concerning a continuous program of science instruction from kindergarten to college:

WHEREAS, The successful functioning of a democracy depends upon the ability of its citizens to think clearly and participate freely in the solution of the ever increasing social and economic problems;

WHEREAS, The methods of science offer one of the best ways through which a citizen may be guided to the truth in making his decisions;

WHEREAS, The task of cultivating scientific attitudes, such as, open mindedness, suspended judgment, willingness to change opinion on the basis of new evidence, search for the whole truth regardless of personal prejudice, the habit of basing judgment on the facts, is a most difficult task absolutely necessitating an extension of training time over the lives of pupils for successful accomplishment.

Therefore, We, the members of the Department of Science Instruction of the National Education Association for the State of California, recommend that boards of education provide for the necessary experimental procedure for the ultimate working out of a continuous program of science instruction from kindergarten to college.

Under date of June 11, 1937, there appears a second report prepared by the chairman of the committee which states that the committee will support the plan for a two-year study of such a continuous program for the country at large, in affiliation with the Department of Science Instruction. The work of the first year will be devoted to a survey of the best thought and practices at the present time. The committee plans to devote the second year to a serious consideration and evaluation of all recommendations received during the first year.

Abstracts

SCIENCE

Thone, Frank. "Grass-Roots." *Science News Letter* 31: 298–300; May 8, 1937.

Some interesting research by the Canadian botanist, F. K. Pavlychenko, in working out the solution of the problem of erosion and weeds has led to some startling results. One crested-wheat plant examined had a total of 319 miles of roots. The article describes in some detail the procedures used in making this determination.

—C.M.P.

Howard, Joseph W. "Opals." *Journal of Chemical Education* 13: 553–556; December, 1936.

Opals are among the most beautiful, the most highly regarded, and the most superstition-ridden of precious stones. They are found chiefly in Australia, Mexico, and the United States. Their chemical composition is essentially $SiO_2 \cdot nH_2O$. Only precious or noble opals are valued as gems. The common opals have little color and are not highly valuable. —V.H.N.

Geithmann, Harriet. "The Glamour of the Giant's Causeway." *Natural History* 38: 166–172, September, 1936.

This is a description of the "Giant's Causeway" in Ireland which extends like a natural pier of cordwood end-on-end for some 300 yards along the coast and out about 500 feet into the North Channel. It is one of the most remarkable examples of prismatic basalt columns in the world. (The Palisades of the Hudson, the Obsidian Cliff in Yellowstone National Park, those along the Connecticut River, the Columbia River and Deschutes River in Oregon are similar.) There are a series of excellent photographs.

—C.M.P.

Talman, Charles Fitzhugh. "Ice from Thunderclouds." *Natural History* 38: 109–119, September, 1936.

This is an excellent article on hail and its causes. India suffers more than any other country from hailstorms. Big tales from big hailstorms have come from there. The largest hailstone on official record is one that fell in Germany August 19, 1925, estimated to have weighed a little less than four and a half pounds. The largest one known to have fallen in the United States fell near Potter, Nebraska, July 6, 1928, and weighed one and a half pounds.

There are a series of excellent photographs, including two on "hail cannon." —C.M.P.

Symposium. "Research Parade." *Science News Letter* 30: 355–359, 362–364; December 5, 1936.

This is a résumé of the demonstrations of scientific achievement arranged by *Science Service* for the Centennial celebration of the American Patent System at Washington, D. C., on November 22 and 23, 1936. —C.M.P.

Andrews, Roy Chapman. "Behind That Door." *Natural History* 38: 185–202; October, 1936.

This is a résumé of some of the world's strangest and most interesting occupations "behind the scenes" at the American Museum of Natural History. —C.M.P.

Damrau, Frederic. "Food or Poison." *Popular Science Monthly* 129: 24–25, 127, 129; November, 1936.

This interesting article discusses some of the strange ailments produced in some people by eating, breathing or touching some common substances. Truly what is one man's food may be another man's poison. The reason for these peculiar effects are not definitely known.

—C.M.P.

Symposium. "Harvard Tercentenary Conference of Arts and Sciences." *Scientific Monthly* 43: 385–490; November, 1936.

This issue contains several of the outstanding addresses given last September at the Harvard Tercentenary: "Constitution of the Stars," by Sir Arthur Stanley Eddington; "Recent Findings in Cosmic-Ray Researches," by Robert Andrews Millikan; "Uncertain Inference," by Ronald Aylmer Fisher; "Hormones," by James Bertram Collip; "The Laws of Mammalian Evolution," by William B. Scott; "Plants and Civilization," by Elmer Drew Merrill; "Culture as a Determinant of Behavior," by Bronislau Malinowski; "Intelligence and the Guidance of Economic Evolution," by Wesley Clair Mitchell, and "The Social Implication of Scientific Research in Electrical Communication," by Frank Baldwin Jewett.

—C.M.P.

Hildebrand, J. R. "Trains of Today—and Tomorrow." *The National Geographic Magazine* 70: 535-589; November, 1936.

This article summarizes important improvements and experiments being made on the progressive railroads of the United States. It is the first such article appearing in the *National Geographic* since 1913. It is the finest article that the abstractor has read upon railroad transportation. There are 51 illustrations.

—C.M.P.

ELLIS, BROOKS F. "The Master Key to Oil." *Natural History* 38: 369–379; December, 1936.

This article describes the methods used by the petroleum geologist in locating buried reservoirs of oil, using microscopic fossils known as Foraminifera, as clues. Oil-bearing rock layers are found in sedimentary rock, usually sandstone or porous limestone, although often in conglomerates and shales. —C.M.P.

WOLF, WILLIAM. "Are You Sane." *Popular Science Monthly* 129: 24–25, 123–124; December, 1936.

This very interesting article describes some mental quirks that produce strange behavior. Many examples of such behavior in well-known personages are included. —C.M.P.

TEALE, EDWIN. "Billboard of Flame." *The Popular Science Monthly* 130: 20–21, 108; January, 1937.

Electric signs now are on a "big-time" basis. The article describes some of the developments in this new magic of the city night skies. One advertising sign on Broadway's "Great White Way" uses as much electricity as a city of 10,000 inhabitants. Some signs rent for as much as $200,000 a year. —C.M.P.

TOLMAN, RICHARD C. "The Present Status of Cosmology." *Scientific Monthly* 43: 491–507, 44: 20–40; December, 1936, January, 1937.

Man's ideas of the universe from antiquity to the present are outlined in this excellent article which is supplemented by 41 excellent photographs and illustrations. —C.M.P.

COLLEGE SCIENCE

DEMING, H. G. "A Chemist Looks at Culture." *Journal of Chemical Education* 14: 12–15; January, 1937.

This article is a plea for a broader interpretation of the concept of culture. Too commonly we interpret culture in terms of classic literature alone, or at least in terms of the literary and artistic, whereas true culture includes much more. The contribution of science in its development of man's understanding and control of his environment is certainly worthy to be considered among the cultural aspects of man's heritage. The lives and works of famous scientists should be known to cultured persons just as well as those of famous artists and writers. The training and experience of a chemist can and should make him a broad, well-rounded individual, who understands our present civilization thoroughly. —V.H.N.

HALE, HARRISON. "Early Chemical Laboratories West of the Mississippi." *Journal of Chemical Education* 14: 62–65; February, 1937.

The earliest recorded chemical laboratory in a college west of the Mississippi was established about 1830 at St. Louis University. Records show that many institutions had such facilities before the Civil War. —V.H.N.

PHIPPS, H. E. "An Objective-type Test for Organic Chemistry." *Journal of Chemical Education* 14: 129–130; March, 1937.

This article describes an objective-type test in organic chemistry based on reaction charts. The various reaction products are designated in the charts by numbers. These numbers are arranged in column form at one side of the sheet and the student writes the formulas of the reaction products opposite the proper numbers. —V.H.N.

Report of the Committee on Examinations and Tests. "The 1935–36 College Chemistry Testing Program." *Journal of Chemical Education* 14: 229–231; May, 1937.

Results are presented obtained through the use of the Cooperative Chemistry Tests for colleges. The data are based on the scores of 1465 students in 35 institutions. —V.H.N.

HOLMES, HARRY N. "The Contribution of the Physical Sciences." *Bulletin of the Association of American Colleges* 23: 67–72; March, 1937.

This is one of a series of articles on "Contributions to Liberal Education in the College" which are included in the March number of the bulletin. It argues the thesis that study in the physical sciences is indeed cultural in the highest degree particularly if it is continually associated with the social implications of scientific discovery and invention and their effects upon the developing history of mankind.

The author emphasizes the following effects which should follow upon well-taught courses in physical science: stimulation of creative imagination; development of absolutely honest attitudes in the search for truth; respect for law and order in the universe; the unification of knowledge; and desire to help humanity in learning to control the forces of nature. —A.W.H.

CARLSON, A. J. "The Contribution of the Biological Sciences." *Bulletin of the Association of American Colleges* 23: 72–82; March, 1937.

In this article the author seeks to show how the biological sciences contribute to the cultural development of the students in college. He suggests the following desirable outcomes: understanding of scientific method; understanding of comprehensive concepts like the theory of evolution and the theory of heredity; concern for and understanding of individual and public health; ability to promote one's own healthful development; knowledge and control of simple

facts of everyday living of which people are in general ignorance at least in habits of application; and faith in the ability of science to solve many of our life problems.

He advocates a general biology course of the survey nature which students may apply in daily living as a more desirable course on the junior college level, and one which is required of all students although he does not stress the concept of the requirement. On the other hand, he pleads for a type of teaching which will attract every student wherein the student will see so much of use and inspiration to him that he feels that he cannot afford to miss it. —A.W.H.

Owen, Wilfred. "Machine-Made Jobs." *Science News Letter* 31: 150–151, 154; March 6, 1937.

Admittedly machines have been a very important factor in bringing about unemployment, but machines at the same time have resulted in much additional employment. (The total effects of the first exceed those of the second.) The article points out new positions created by machines in clerical work, printing and automobiles. —C.M.P.

Long, C. H. "Sectioning a General Physics Lecture Course in Order to Adapt Instruction to Ability." *School Science and Mathematics* 36: 510–514; May, 1936.

This is a report of a learning study undertaken "for the purpose of determining the most suitable basis for the division into two groups of the students in one of the new required general courses for freshmen and sophomores in college . . . so that instruction could be suited to ability" of superior and slow groups. Some of the significant conclusions of this study are these: "Students who have studied high school physics tend to do somewhat better work in [this course in] college physics than those who have not." "Sectioning based on intelligence scores is in the main, satisfactory, since the study shows only a moderate overlapping of the two groups and the need for relatively few transfers." "The best sectioning is obtained by combining intelligence scores and the study of high-school physics." "A good sectioning is also obtained by employing term grades in [the] . . . work of the previous quarter in physical science in conjunction with the study of high-school physics." —F.D.C.

Morrison, Edwin. "Can College Physics be Popularized?" *The American Physics Teacher* 4: 117–119; September, 1936.

Recent surveys show that there are almost three times as many students pursuing chemistry as physics, with eight students majoring in chemistry to one majoring in physics. Physics has lost the popularity it once had. The author suggests reasons for this, maintaining that the reasons are not because of physics itself but the way it is taught. It is taught too largely as a fact-getting-textbook subject. It should be taught on a more experimental basis.

—C.M.P.

SECONDARY SCIENCE

Dunbar, Ralph E. "The Organic Content of Twelve High-School Chemistry Textbooks." *Journal of Chemical Education* 14: 115–117; March, 1937.

A wide variation was found in the proportion of total space in each of twelve high-school chemistry textbooks which was devoted to organic chemistry. The range was from 11.4 to 58.6 per cent. Among the books written for general purposes and widely used, the variation was from 11.4 to 21.5 per cent. Practically all the books easily cover the "Outline of Essentials for a Year of High-School Chemistry."

—V.H.N.

Ham, L. B. "High-School Physics as Preparation for College Physics." *The American Physics Teacher* 4: 190–194; December, 1936.

This report is based on a study of 310 students at New York University and 110 students at the University of Arkansas. Results of the study do not confirm the common statement that high-school physics has no value for college physics. This study would indicate some positive values. Also the study does not confirm the opinion that mathematics is definitely a more important contributor to higher final college-physics grades than high-school physics. The results in this case are non-committal. —C.M.P.

Tyler, Ralph W. "The Significance of a Comprehensive Testing Program." *Journal of Chemical Education* 14: 158–160; April, 1937.

Tests may differ in form as well as in content. There is danger sometimes that test makers and users place too much emphasis upon form to the neglect of purpose. The important consideration in testing is to determine what the testing is for, or what objectives of instruction are to be measured. No single test can be expected to measure all the desirable objectives of a course. Separate tests must be devised for different objectives. These can then be used as desired and according to the purposes and emphases of the instruction. —V.H.N.

Brown, F. D. "Difficulties in the Application of Uniform Tests in Chemistry." *Journal of Chemical Education* 14: 166–168; April, 1937.

Six important obstacles to a uniform national testing program in chemistry are discussed. It is admitted also that such a program might have some advantages.

—V.H.N.

New Publications

JAFFE, BERNARD. *Outposts of Science.* New York: Simon and Schuster, 1935. 547 p. $3.75.

The subtitle of this Scientific Book Club selection indicates the nature of the treatise, "A journey to the workshops of our leading men of science." It is based on a personal tour of fifty of the most important research laboratories in the United States and the material of each chapter was submitted to the revision of a number of scientists whose work it describes in detail. The story of each piece of research is built around the accomplishments of an outstanding authority in that field. The author has been able, out of the tangled mass of material found in Sunday supplements, popular scientific articles and technical research treatises, to write one of the finest descriptions of what is going on in scientific research laboratories, what has been accomplished, with an indication of the more numerous problems yet to be solved.

Thirteen fields have been selected for intense discussion. However, the reviewer cannot agree with the author's contention that "intrinsic difficulty of the subject, the lack of general interest and the paucity of scientific experimentation" afford a reasonable excuse for ignoring the fields of "relativity, geology and psychology," especially the latter two. Sad indeed must be the plight of research work in these two fields, if they do not merit a place in discussions on research, for in the field of geology America leads the world.

The thirteen fields of research discussed are Genetics, Anthropology, Physical Disease, Cancer, Glands, Mental Diseases, Vitamins, Insects, Matter, Radiation, Astrophysics, Weather, and Galaxies. —C.M.P.

COLLINS, A. FREDERICK. *The New World of Science.* Philadelphia: J. B. Lippincott Company, 1934. 308 p. $2.50.

The New World of Science describes some of the scientific aspects and exhibitions at the Chicago Exposition of 1933 and 1934. Certainly at the Chicago Fair science and its accomplishments received comparatively a greater emphasis than in any previous fair. Even the initial opening by the light from the star Arcturus emphasized the scientific basis. A few of the other exhibits described include television, robots, the radio transmission of power, the photoelectric eye, cosmic rays, the stroboscope, research work on the structure of the atom, and the Adler Planetarium. Science teachers as well as high-school boys and girls will enjoy reading this book. —C.M.P.

COLLINS, A. FREDERICK. *How to Understand Electricity.* Philadelphia: J. B. Lippincott Company, 1935. 326 p. $2.50.

This is a useful supplementary book for boys and girls studying electricity in physics or general science classes. It is essentially a book for beginning. The author traces the development of man's idea of the nature of magnetism and electricity and many of the uses to which he is now putting these new servants. —C.M.P.

COLLINS, A. FREDERICK. *Fun With Electricity.* New York: D. Appleton-Century Company, 1936. 238 p. $2.00.

This book supplements the book reviewed above, *How to Understand Electricity.* It is essentially a book of experimental electricity, making the two books excellent sources of experiments for demonstrations in classwork and in the science club. Experiments with direct current, alternating current and high frequency current are included.

The author has brought out some sixty-odd books on such varied topics as wireless, astronomy, chemistry, mechanics, magic, physics, photography, submarines, gyroscopes, etc. Mr. Collins, a native of South Bend, Indiana, is an electrical physicist of note and a Fellow of the Royal Astronomical Society. —C.M.P.

COLLINS, A. FREDERICK. *The Radio Amateur's Handbook.* New York: Thomas Y. Crowell Company, 1933. 419 p. $2.00.

This is the seventh edition of a book first appearing in 1922. It forms a fairly complete, authentic and informative work on radio telegraphy and telephony. The number of editions attests to the popularity of the book and the reviewer can attest to the fact that high-school boys interested in radio find it both readable and practical. There is a useful appendix, glossary, and a supplement with a list of radio "don'ts," insurance requirements, laws and regulations. —C.M.P.

LANGDON-DAVIES, JOHN. *Radio.* New York: Dodd, Mead and Company, 1935. 278 p. $2.50.

This book, in simple, non-technical language, describes how a radio works and explains the underlying principles. No details are given as to construction of a radio set. The purpose of the book is to explain and this it does so that nonspecialists in electricity and radio get a better understanding of one of the marvels of this scientific age. Elementary science and general science teachers, as well as junior high school and senior

high-school students will find this a useful, readable book. —C.M.P.

Chase, Stuart. *Rich Land, Poor Land.* New York: Whittlesey House, 1936. 361 p. $2.50.

Before the coming of the white man, America was a vast continent, luxurious with forests, prairie grass and brooks and rivers, a land rich in bird, fish and animal life, a country of enormous mineral wealth. Today, America is rapidly becoming a poor land through the wastrel methods and policies of the American people. America has been exploited and in the recent dust-bowl storms and the present flood—the greatest in our history—we are reaping what we have sown.

In the first part of the book Chase discusses the following blighted areas: (1) Crop-land areas where 100 million acres of once-fertile soil are now eroded beyond any hope of a livelihood, and even more extensive areas are sadly depleted; (2) Grass-land areas where 165 million acres are on the way to ruin through overgrazing, fire, the plow, dust and drought; (3) Forest-land areas—half of our forests gone; (4) Watershed areas—depletion of ground water in Central Valley and the floods of past and the recent one—most destructive in our history; (5) Wild-life areas—salmon, game birds and wild animals; (6) Mining areas—metals, coal and petroleum.

The last part of the book proposes remedies and discusses the merits and disadvantages of projects now being used to conserve our natural resources. Chase says ' must plan with nature," if we are to save . continent. There is plenty of work to do to employ all the unemployed if we have the vision and the courage to save the natural resources of America.

The author is well known through his earlier *The Tragedy of Waste, Men and Machines,* and *The Economy of Abundance.* In none of these has he excelled *Rich Land, Poor Land* which is recommended as an excellent reference book for science classes where the problems of conservation are being considered. Science teachers will enjoy reading this prophet crying in the wilderness, joining those earlier prophets, Darling, Howard, and others, in warning us of the fate of nations that heedlessly and wantonly waste their natural resources. —C.M.P.

Wilson, P. W. *The Romance of the Calendar.* New York: W. W. Norton and Company, 1937. 351 p. $3.00.

The Romance of the Calendar is timely, inasmuch as there is a very great possibility that a new calendar will be adopted in 1939—the first calendar reform since the Gregorian calendar of 1582, later adopted by Great Britain and her colonies in 1752. The history of man's attempts to work out an accurate, usable time-measuring scheme parallels his growth in culture. Time-measuring devices are traced from remotest antiquity and among peoples of every race. What a battle raged between the sun and the moon as authority over the calendar, ending in the triumph of the solar year over the lunar month.

The present calendar has certain disadvantages which has led to the present agitation for reform. Two calendars have been proposed as better meeting modern needs—the thirteen months or International Calendar, and the twelve months or World Calendar. The latter part of the book is devoted to a discussion of the advantages and disadvantages of each of these plans. The World Calendar would seem to have an excellent chance of being adopted in 1939.

Altogether *The Romance of the Calendar* constitutes the best book that we have on the calendar, but in many respects it does not attain the excellence of many articles that have appeared in the *Journal of Calendar Reform.* —C.M.P.

Finch, Vernon C., and Trewartha, Glenn T. *Elements of Geography.* New York: McGraw-Hill Book Company, 1936. 782 p. $4.00.

Elements of Geography may be used as a college textbook or reference book. It is written in a pleasing, readable style. The pictures are recent, and many aerial views are given; captions are enlightening and most interesting. Diagrams, and maps of a locational and comparative nature further supplement the textual material. An examination of the contents page reveals the usual method of organization which has been followed in the past in writing textbooks in this field. The section on Landforms and the one on Earth Resources are most complete and well organized. The discussion of Loess Plains as to their origin, nature and location are one of the many examples of scholarly research and clarity, typical of the book. Students will object to the type, although varied, as it is too small on the whole and will prove tiring on the eye. Also the objection, which may be made of other geography textbooks today, is that the book is large, heavy and expensive. The book might have been published in Book I and Book II form at a reduced price. Efforts should be made in general to reduce both the price and size of geography textbooks. —C.M.P.

Minnich, Harvey C. *Old Favorites from the McGuffey Readers; William Holmes McGuffey.* New York: American Book Company, 1936. 482 p., 203 p. $3.50 and $2.25 (both volumes $5.00).

This year 1936 marked the hundredth anniversary of the appearance of the first McGuffey Reader. No other series of books has molded the mental, moral, and religious lives of so many thousands of young Americans, especially in the Middle West. Along with Webster's Blueback Spelling Book, and Ray's Arithmetic, the McGuffey Readers have been the American standard. Many McGuffey societies have been formed commemorating the life of this educator of Ohio and Virginia. From the year 1836 until near the

close of the century he exerted the greatest influence culturally of any person in American history.

Old Favorites consists of one hundred and fifty selections from the McGuffey Readers, beginning with the First Reader and ending with the Sixth Reader. The second book relates some of the life events of McGuffey, together with an analytical study of the Readers.

The McGuffey Readers are noted for their direct moral teaching, for which among other things they have been severely criticized. But certainly they were as suited to that day as many of our books are for today. It is unlikely that again shall we witness a series of books so dominating the thoughts and readings of so many millions of people. —C.M.P.

GARRISON, NOBLE LEE, *The Technique and Administration of Teaching.* New York: American Book Company, 1933. 693 p. $2.50.

Science teachers desiring a good modern textbook on techniques of teaching will find it in this book. The author recognizes the futility of much that was done formerly in the conventional classroom, but at the same time recognizes the necessity of providing for the organization of experience and for the discovery of worth-while types of work. The author is Director of Elementary Education at the Michigan State Normal College at Ypsilanti. Chapter headings are as follows: "Independence and Power in Teaching;" "The Meaning of Pupil Development in Teaching;" "Power Objectives as Guides in Pupil Development;" "Basic Factors in Learning;" "What Outcomes of Learning Should Be Sought;" "What Learning Techniques Should be Used;" "How to Control the Learning Activities of Pupils;" "The Two Main Objectives of Classroom Instruction;" "The Administrative Activity of Teaching;" "The Technique of Teaching;" "Diagnosing and Improving the Instructional Activities;" "Creative and Textbook Teaching;" "Planning for the Instructional Activities;" "How to Establish Good Methods and Habits of Study;" "Improving Teaching Through Control of External Factors;" "Adapting Work to Individual Differences of Pupils;" "Pupil Motivation;" and "Guides in Selecting Worth-while Content." —C.M.P.

CASWELL, HOLLIS L., AND CAMPBELL, DOAK S. *Curriculum Development.* New York: American Book Company, 1935. 600 p. $2.50.

This book is one of the most constructive books that has appeared in the field of curriculum revision. Based on a wealth of practical experience, the authors, who are professors of education at the George Peabody College for Teachers, have brought together the best current thought with respect to the aims and purposes of education. Objectives to be achieved are analyzed and techniques essential in the development of curricula are presented. The scope of the book may be judged on the basis of the following topics: "Challenge of Contemporary Life to the School;" "The Social Responsibility of the School;" "Significant Influences of Curriculum Development;" "Concepts of the Curriculum;" "Principles Basic to Curriculum Development;" "Aims of Education;" "Scope of the Curriculum;" "Pupil Purposes;" "Activities for Realization of Purposes;" "Selection of Subject Matter;" "Grade Placement and Time Allotment;" "Teaching Procedures;" "Evaluating the Outcomes of Instruction;" "Organizing Instruction;" "The Unit Basis of Organizing Instruction;" "The Course of Study;" "Administrative Considerations in Curriculum Development;" and "Administrative Organization in Curriculum Development." —C.M.P.

EVERETT, SAMUEL (editor). *A Challenge to Secondary Education.* New York: D. Appleton-Century Company, 1935. 353 p. $2.00.

In *A Challenge to Secondary Education* thirteen members of the Society for Curriculum Construction unite in presenting a symposium in which is described theoretical and practical proposals for redirecting the efforts of secondary schools. On many points there is general agreement; on other points there is a sharp disagreement. Consequently after reading the book one may feel somewhat confused; yet the book is quite stimulating and challenges one's thinking. The topic discussed and the author are as follows: "American High Schools Must Be Reconstructed," Samuel Everett; "The Core-curriculum Plan in a State Program," Sidney B. Hall and Fred M. Alexander; "New Schools for a New Day." W. B. Featherstone; "Secondary Education as Orientation," U. T. Thayer; "The Rural High School," C. Maurice Weiting; "Essentials for a Secondary School," R. D. Linquist; "A Program for American Youth," Goodwin Watson; "A Plan for the Junior College," George H. Merideth; "A High School for a Modern Age," James E. Mendenhall;" "Reconstructing Secondary Education," William L. Wrinkle; "Social Direction for Education," C. L. Cushman; "Modernizing the American High School," Samuel Everett; "Education as a Community Function," G. Robert Koopman; "Analysis of the Plans," Samuel Everett. —C.M.P.

PAYNE, FERNANDUS AND SPIETH, EVELYN WILKINSON. *An Open Letter to College Teachers,* Bloomington, Indiana: The Principia Press, 1935. 380 p. $3.25.

The authors present and discuss some of the more significant developments in higher education from the point of view of the college teacher. The introduction presents some criticisms of college teaching handicaps of college teaching, and some problems in the education of the teacher. Following this is a discussion of some experiments being carried out at Minnesota, Antioch College, Chicago, Claremont Colleges, Colorado College, Bennington College, Bard College, Ohio State and Cornell.

A chapter is devoted to a description of how great teachers teach. Among the teachers discussed are: David Starr Jordan, Henry Adams, William H. Kilpatrick, William Lyons Phelps, G. Stanley Hall, William F. L. Sanders, Daniel Kirkwood, Friedrich Paulsen, George H. Howison, Henry M. Belden, Franklin P. Mall, and Mark Hopkins. The last chapters are devoted to the problems of measurement of abilities and achievement and suggested changes to better college teaching. The selected bibliography lists 430 pertinent discussions and research studies.

—C.M.P.

CAIGER, STEPHEN L. *Bible and Spade*. New York: Oxford University Press, 1936. 218 p. $2.00.

The purpose of this book is to give a general survey of the main discoveries of archaeology in so far as they concern the Old Testament, especially on its historical side. Recent excavations in the Ancient East throw much light upon the Hebrew language, the early chapters of Genesis, the Flood, Abraham, the sojourn in and the exodus from Egypt, Moses, David, Solomon, Babylon and the Exile. Peculiarly enough, these excavations have substantiated the historical accuracy of many Biblical accounts, in numerous cases offering the very first historical proof.

Archaeology is an interesting science and no phase is more interesting than that relating to those ancient peoples about whom the most has been written. —C.M.P.

CURTIS, FRANCIS D. *Workbook-science for Today*. Boston: Ginn and Company, 1936. 197 p. $0.60.

This is a workbook to accompany the textbook *Science for Today* by Caldwell and Curtis. It contains nearly two hundred experiments or things to do including with each a statement of the problem, the materials needed, procedures and observations and conclusions in the form of questions to be answered. In addition there are frequent exercises on scientific attitudes and scientific methods. The workbook is well illustrated and contains plenty of space for writing up the results of experiments, and conclusions.

—V.H.N.

POWERS, S. R., NEUNER, ELSIE F., AND BRUNER, HERBERT B. *Directed Activities II* and *Directed Activities III*. (Workbooks to accompany *This Changing World* and *Man's Control of His Environment*, by the same authors.) Boston: Ginn and Company, 1936. 125 p., 151 p. $0.48 and $0.52.

These workbooks are intended to guide pupils in their study of the respective textbooks by the same authors for second and third years of work in science in junior high schools. Each workbook parallels in its organization the units presented in the text. Workbook II contains six units dealing primarily with what was once primarily taught as physical geography including a little of astronomy, weather and climate, zones, geology and elemental facts about energy. Book III deals in eight units with man's control over his physical environment. Each unit is organized as four or five problems in the form of questions. Each problem includes leading questions, references for reading and questions for review. The books are well illustrated and filled with suggestions and devices to stimulate activity and practical applications. With each book comes a set of objective test questions intended to cover each unit.

Although these workbooks give every sign of careful organization, thoroughness, and accuracy, one is tempted to ask whether they will really interest children between the ages of 12 and 15. They seem rather advanced and technical for the average junior high-school pupil. No doubt these materials have all been thoroughly tested on pupils at these levels, and have been found suitable. There is also a question as to the adaptability of these materials for use with textbooks in science by other authors. They are organized to follow the plan of the textbooks by the same authors, which put into concrete form the recommendations of the Thirty-first Yearbook. It is difficult to see how they could readily be adapted for use with textbooks which do not conform so closely to these ideas. Except for these possible criticisms, the authors and publisher are to be commended for a substantial contribution.

—V.H.N.

DULL, CHARLES E. *Modern Chemistry*. New York: Henry Holt and Company, 1936. 745 p. Appendix. $1.80.

This revision of one of the best known high-school textbooks of the past two decades needs no introduction to most readers. The reviewer first came in contact with Dull's books in the 1918 edition as a beginning teacher. That book had little more than half as many pages as the latest edition and far less than half as many illustrations. A study of the four editions through which this book has run shows clearly the development of the course in high-school chemistry during the period covered.

A careful comparison of the 1936 edition with its immediate predecessor, that of 1931, shows few changes. Only the following are evident: The problems in the 1931 edition have been separated at the end of each chapter into two groups —the easier ones in Group A and the more difficult ones in Group B; second, certain topics have been marked for possible omission in non-college preparatory courses; third, some new illustrations, mostly photographs, have been introduced.

The major changes were made between the first edition (1918) and the 1925 and 1931 editions. A high standard has been set upon which it is difficult to improve without fundamental reorganization of the entire work. For those who want one of the best books available in the traditional mode of organization and presentation of chemistry for high-school pupils, this book is hard to beat. —V.H.N.

LONG, ERNESTINE M. J. *Living Chemistry.* St. Louis: John S. Swift Co., Inc., 1935. 225 p. $1.00.

In this publication, the basic material of a first course in high-school chemistry is presented in nine units. These units deal respectively with "Oxygen," "Hydrogen," "Atomic Structure" (including equations), "Ionic Theory," "Weight and Volume Relations," "Non-Metals." "Metals," "Carbon Compounds" and "Colloids." Each unit includes a plan of the unit, lecture and study material, some ideas on scientific attitudes and scientific method and experiments. The appendix includes some suggestions on laboratory management and supplies, and on library supervision, a bibliography, a copy of a test on scientific thinking and sample examination questions. The book is letter size with a spiral wire binding. There are very few illustrations.

This work is apparently intended to supplement rather than replace a textbook. The author states in the preface "The material in this book has been arranged so that it may be used with any chemistry text." It appears to be a combination of textbook and laboratory manual, although not really a complete one of either. Neither can the volume be classed as a workbook. It contains few suggestions for study. There are numerous exercises for study in the form of completion questions, short essays to write, and reading references. A novel feature is a time schedule for each unit indicating how long each should take when various assignments are due. The work is well-organized, for the most part. and the questions are usually worded so that the pupil must find out for himself rather than to look up the answer. This is an excellent feature. This book used with a good textbook or set of reference books readily available should add materially to the value of a course in high-school chemistry. —V.H.N.

TEETERS, WILLIAM R., BRIDGES, RUSSELL E. AND LEE, WILLIAM C. *Workbook for Science at Work.* Chicago: Rand, McNally & Company, 1936. 200 p. $0.64.

This workbook is organized in seventeen units which parallel exactly the organization of the textbook *Science at Work* by the same authors. Each unit is divided into problems which also are the same problems as are found in the textbook. The units deal with such things as air, heat, light, labor saving devices, cleanliness, food, health, fire, plants, sound, the universe, and science in life and in industry. Each problem consists of a series of questions to be answered by reference to the textbook. At the end of each unit is a test called a self-checking exercise. A key for all tests is given at the end of the book. This workbook is long on questions but short on pupil activities. There are few suggestions of things to do, experiments and the like; there are no illustrations and no reading references outside the textbook. It will probably not be used widely by those who do not use the authors' textbook. —V.H.N.

ROBERTS, G. F. AND SMITH, H. C. *Mastery Units in Chemistry.* New York: Colonial Book Company, 1936. 245 p. $0.67.

This booklet aims to present the essential facts of elementary chemistry in brief form. It is designed primarily to prepare pupils to pass New York State Regents' Examinations and similar requirements. There are comparatively few illustrations and no photographs. The material is said to be organized into units but these are scarcely more than a grouping of the usual chapters found in almost all textbooks. The volume presents a brief readable summary of the essential facts of chemistry with a minimum of applications, illustrations and supplementary material. —V.H.N.

IDELSON, MICHAEL N. *Mastery Units in Physics.* New York: Colonial Book Company, 1936. 250 p. $0.67.

This is a companion volume to the *Mastery Units in Chemistry* under the present author's editorship. It aims to present in brief readable form the elements of physics needed by the pupil to pass New York State Regents and similar examinations. The booklet is more profusely and better illustrated than the one in chemistry. The units are composed of groups of chapters which are usually included in an elementary treatment. Sample Regents' Examinations of recent years are given. The "ideographs" are drawings intended to vivify concepts of importance in physics. They add interest and probably contribute to the pupil's understanding. —V.H.N.

WELLS, HARRINGTON. *The Teaching of Nature Study and the Biological Sciences.* Boston: The Christopher Publishing House, 1936. 333 p. $4.00.

This book is a handbook on methods covering the sequence of subject matter and classroom technique in science from kindergarten to college. It gives source lists for the various grades of materials, books, bulletins, visual aids and help in the planning of classroom units and course outlines in hygiene, biology, botany, and zoology.

It can be used in connection with a methods course or a professionalized course in the teachers college equally well, or by the teacher in service. The material is stimulating and intensely practical. —L.M.S.

SYMPOSIUM. *Keystone Primary Series.* Meadville, Pennsylvania: Keystone View Company.

The books in this series have been written to accompany the *Keystone Primary Set* of stereographs and lantern slides. The authors are specialists in reading. They not only understand the techniques of helping children learn to read but also understand boys and girls. The books have been developed in such a way that children learn to read about the things they enjoy, are interested in, and with which they have had experiences. The books provide delightful reading

material for young children who are learning to read or who have just learned to read. The vocabulary is well chosen with special attention to aid in facilitating reading. Throughout the books, references are made to lantern slides and stereographs which will help give a better understanding of the stories and greater enjoyment in reading. The following books are included in the series:

ZIRBES, LAURA AND WESLEY, MARIAN J. *The Story of Milk.* 1926. 97 p. $0.68.

This book is written for boys and girls who have just learned to read. Its stories are about experiences that are common in everyday life, such as the milkman bringing milk; visiting the farm; going to grandmother's; visiting a big dairy farm; and talking about things made of milk. The style is rhythmic. The repetition tends to make the book easier to read and to make for rapidity in reading. The book contains many suggestions for guessing games, telling, doing, testing, and making pictures.

ZIRBES, LAURA AND WESLEY, MARIAN J. *Workers.* 1929. 97 p. $0.58.

This book is written for young children who can read. It tells in an interesting way something about the work that mother does in the home and the different kinds of work that fathers do, such as policeman, carpenter, doctor or farmer, and the work some fathers do in mills and factories. Throughout the book are suggestions of interesting things to do, to make, questions to answer, and games to play. At the close of the book are valuable suggestions for the teacher.

KELIHER, ALICE V. AND ZIRBES, LAURA. *Animal Tales.* 1930. 85 p. $0.51.

This book tells in a delightful way stories about animals commonly found in the zoo. It contains suggestions of interesting things to do and gives directions for making toy elephants, camels, and a circus. It contains suggestions for choosing and best answer games and gives a number of riddles that relate to the reading material. Suggestions to the teacher for using the book and a careful vocabulary analysis are included.

ZIRBES, LAURA AND KELIHER, ALICE V. *The Book of Pets.* 1932. 102 p. $0.58.

This book is for young children who are learning to read. They learn to read through stories of pets which they commonly enjoy, such as a dog, cat, horse, pony, canary, hen and chicks, duck, and rabbit. Throughout the book are suggestions of things to make, to do, games to play, and questions to answer. The authors include a section of suggestions for the teacher and a list of new words developed in the book.

—F.G.B.

Compton's Pictured Teaching Unit-Materials. Chicago: F. E. Compton & Company, 1935.

Each unit includes: (1) a *Teacher's Handbook,* (2) twelve Picture Plates giving fifty or more illustrations in color, (3) a Basic Source Material Booklet. A set of objective tests not inclusive, but suggestive to the teacher accompanies each unit. The simplicity of the material and the interest of the selections recommend them to teachers.

Coal and Iron. This pictorial unit deals with the development of the coal and iron industries; the importance and the interdependence of each in modern life; the chief coal and iron regions of the world; the problems of workers and owners in the coal and iron industries. The pictures of ancient plant life are especially good for use in the science class.

Communication. The importance of communication in human life, the development of the various branches, modern problems, and the future of communication, are the phases of this unit. Of especial value in the science work are the pictures on the telegraph, photography, radio, submarine cable, and the telephone.

Transportation, Water and Air. The history of water and air transportation, modern problems of water transportation, man's conquest of the air are taken up in this unit. Material definitely adapted to the science work are the pictures on the use of sun and stars to man, instruments and methods of navigation, locks, measuring of wind and weather, development of airplane and of dirigible, steam, gasoline, and Diesel power.

—L.M.S.

DUGGAN, ANNE SCHLEY. *A Comparative Study of Undergraduate Women Majors and Non-Majors in Physical Education with Respect to Certain Personal Traits.* New York: Bureau of Publications, Teachers College, Columbia University, 1936. 117 p. $1.60.

This study presents a thorough survey of the type of young woman entering the profession of physical education to-day as compared with those entering other fields. —L.M.S.

WHITNALL, HAROLD O. *A Parade of Ancient Animals.* New York: Thomas Y. Crowell Company, 1936. 135 p. $2.00.

This is a very readable book about prehistoric animals, adapted to use in the elementary school. It is well-written, beautifully illustrated, and will make excellent supplementary reading in science work. —L.M.S.

HENDERSON, W. B. *Physics Guide and Laboratory Exercises.* Chicago: Lyons and Carnahan, 1936. 360 p.

The objectives of this guide are: (1) to help the student to help himself in his lesson and laboratory exercises, (2) to help the teacher by relieving him of much routine work in the assignment of lessons, special directions and individual explanations.

The material is presented in units, with divisions into practical problems under each unit. For example: Unit 2 on *Cases* includes "Problem 15. How can you predict when it is going to rain," and "Problem 20. How can you make water run uphill"; Unit 4 on *Solids:* "Problem 32. What does your radio announcer mean when he says. 'This station has a frequency of 77 kilocycles'"; and "Problem 36. Why should you never hit a baseball at the very end of the bat."

This arrangement should stimulate the pupil. Experiments are given, with careful directions and questions, practical applications, and self tests for the student. —L.M.S.